0073900

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
3100 Port of Benton Blvd • Richland, WA 99352 • (509) 372-7950

September 12, 2007

Mr. John P. Sands
Richland Operations Office
United States Department of Energy
P.O. Box 550, MSIN: A3-04
Richland, Washington 99352

Re: Department of Ecology review comments for the Risk Assessment Report for the *100 Area and 300 Area Component of the River Corridor Baseline Risk Assessment, DOE/RL-2007-21, Draft A*

0073124

Dear Mr. Sands:

Ecology's review comments on the referenced document are enclosed. Broad issues of concern include the following:

- The purpose of the document is not clearly stated. It is necessary to inform the reader that this risk assessment is not a typical baseline risk assessment, but instead an assessment of protectiveness of interim measures.

- Variability in the data and pooling of data from many waste sites and sources preclude detection of statistically significant differences between waste sites and reference sites.

- The human health risk assessment is confounded by issues related to the complexity of the contaminant spatial distribution assumptions, site usage assumptions, use of background data, isolation of pathways, and elevated contaminant detection limits.

- Calculations are difficult to replicate because data are difficult to find within the document and not clearly linked to the necessary equations.

- Protection of the vadose zone, groundwater, and ultimately surface water pathways is not demonstrated.

If there are any questions, contact me at 509-372-7921 or Beth Rochette at 509-372-7922.

Sincerely,

John B. Price
Environmental Restoration Project Manager
Nuclear Waste Program

br/aa
Enclosure

cc w/enc:
Alicia Boyd, EPA
Larry Gadbois, EPA
Stacy Charboneau, USDOE
John Morse, USDOE
Don Steffeck, USFWS
Stuart Harris, CTUIR
Gabriel Bohnee, NPT
Russell Jim, YN
Susan Leckband, HAB
Ken Niles, ODOE
Mary Baker, NOAA
Administrative Record: 100 and 300 Area
Environmental Portal

cc w/o enc:
Ella Feist, WCH
Larry Hulstrom, WCH
Jill Thomson, WCH

Washington State Department of Ecology Comments
Risk Assessment Report for the 100 Area and 300 Area Component of the River Corridor Baseline Risk Assessment (DOE/RL-2007-21, Draft A) -Combined (9/07)

Comment Number	Section, Page, Paragraph	Comment
1.	General	The document does not clearly deliver the purpose of this assessment. The purpose / objectives are not clear about whether this assessment is for the post-cleanup sites and/or cumulative assessment of all existing contamination. Please clarify. The overall readability of the document is poor.
2.	General, and p. 6-50, 6-51	The concept of "uncertainty" and its assessment are completely ignored in the entire document. These uncertainties can be in the sampling, contaminant transport, modeling, selection of COPC, etc. A probabilistic approach could be applied to understand the concept. Analysis of uncertainty is a requirement for ecological risk assessment, so the analysis should both describe the uncertainty (quantifying where possible) and identify the significance of these uncertainties. (DG)
3.	General	Provide a table with appropriate description showing the results of the following assessment scenarios: a. Assessment at post-cleanup soil sites b. Assessment at water table below the post-cleanup soil sites c. Assessment at riparian zone or any other assessment /point of calculation used (DG)
4.	General	An assessment endpoint is not simply a group of receptors (e.g., p. ES-14, paragraph 2). An assessment endpoint is defined by an ecological entity (e.g., species, group of species, ecosystem function) and its attributes (e.g., a quality or characteristic of an ecological entity). Furthermore, assessment endpoints are ecological values (providing a framework for measuring stress-response relationships), not management goals (EPA, 1998, EPA/630/R-95/002F). An example of an assessment point is salmon reproduction and age class structure. (DD)
5.	General	A repeated result (e.g., plants, small mammals, carnivorous mammals, riparian invertebrates, aquatic biota, sediment biota) for eco risk is HI>1 with no difference between waste (operational) site vs. reference site. Although this is attributed to natural background levels of certain COPCs, it could indicate a problem with selection of reference sites (e.g., contamination) and a need for further evaluation. The general lack of statistical difference between waste site vs. reference site is often due to the large variability in the data. (DD)
6.	General	Although laboratory toxicity bioassays may employ site media, bioassays typically lack environmental realism (e.g., in situ physical/chemical properties [e.g., temperature, pH, redox], chronic exposure, other ancillary site variables), while imposing greater control. In contrast, field studies lack control but incorporate greater realism. Therefore, toxicity tests should not necessarily be weighted higher than field studies. (DD)
7.	General	Please number all equations. (DD)
8.	General	The transparency of the human health risk assessment is compromised, due

Comment Number	Section, Page, Paragraph	Comment
		to methods addressing background and certain exposure pathways. For example, there is reference background, operational background, Hanford background, and Washington state background, while several pathways are isolated due to their large contribution to risk (e.g., fish ingestion, domestic use groundwater pathways, naturally occurring soil/biota radionuclides). (DD)
9.	General	In a subset of samples in various media (e.g., soil, fish tissue), PCBs should be analyzed by Method 1668 for individual PCB congeners (in addition to Aroclor analysis), including the 12 World Health Organization (WHO) dioxin-like congeners. The WHO congeners should be evaluated with the WHO toxicity equivalency factor (TEF) method. (DD)
10.	General	There is a fundamental problem with the methodology for determining the representative contaminant concentrations. The problem may arise from too few samples for an analyte at a site, or from an inappropriate statistical method to calculate mean and UCL values, or both. Regardless, the problem shows up as inflated representative contaminant concentrations. Many of the high radiation doses reported in this document, and the corresponding high risks, are totally or in part due to artifacts of the methodology to determine representative concentrations. These high dose results do not present an accurate description of residual contamination or the cleanup progress. Specifically, there are cases where the RME exposure point concentrations, which are derived from the representative concentrations, greatly exceed the maximum measured concentration. There are also cases where the RME concentration is set to an inappropriately high detection limit for an analyte that was not detected. In either case, the result is a grossly exaggerated exposure point concentration that leads to unrealistically high radiation doses and risks. Specific examples are cited in additional comments. These problems need to be resolved before this report can be finalized. (SV)
11.	General	It is not clear from the description of the RCBRA scope, how source and groundwater integration in the river corridor has been addressed by or incorporated into the risk assessment. The risk assessment includes a very limited assessment of groundwater risk and does not include assessment of the vadose zone beyond waste site boundaries. (JAS)
12.	General	The text (ES-12, Section 5.8, Tables 5-66 to 5-83) references monitoring wells using "Well ID" (e.g. A4614) or "Well Name" (e.g. 199-N-80). It is recommended that the text consistently refer to all wells by their "Well Name" as this allows the reviewer to understand the location of the well. For example, the text refers to well A4614. It would be easier to understand

Comment Number	Section, Page, Paragraph	Comment
		the location of this well if the Well Name (199-H4-10) was given. (JAS)
13.	General	The document should devote a chapter to addressing "background" concentrations. The chapter should cover natural radioactivity, arsenic sources, PCBs and PAHs, and differences between sample collection and analysis for this risk assessment relative to sampling and analysis methods used for the "background" reference documents (such as DOE/RL-94-72). The chapter could also discuss the reference sites and observations about potential contamination (or lack thereof) at the reference sites. Appendix E could be combined with the background chapter. (BR)
14.	General	The data analysis approach involved a great deal of pooling of results from many sites (examples: box plots and bivariate plots for tissues). This creates variability that prevents drawing conclusions about the risk and potential need for cleanup at individual sites. It forces a situation where the pooled site data show no statistical difference from the reference sites. Additional analyses should be performed by comparing each site against appropriate reference sites and state and federal screening levels. (BR)
15.	General	The approach used for risk assessment for RCBRA and that for the 300-FF-5 operable unit RI/FS should be consistent. This is not to say that the RCBRA methods should be replaced with the methods used for 300-FF-5, but that the two should be adjusted to allow integration. Also, results for the 300 area for RCBRA, when pertinent to the 300-FF-5 risk assessment, should be used in the 300-FF-5 risk assessment and vise versa. Please consult the 300-FF-5 risk assessment for useful data for this risk assessment. The United States Department of Energy (USDOE) should assure integration and consistency of the two risk assessments. (BR) (JP)
16.	General	Include in an addendum example calculations for 5 to 10 waste sites showing the calculation of incremental lifetime cancer risk, hazard quotients and hazard indices, and doses for all pathways and scenarios. Most readers will find it very difficult to replicate calculations due to the structure of the document (individual results for sites are hard to find). Demonstrating that the calculations are valid is one of the burden of proof requirements associated with risk assessments and determinations of cleanup levels (WAC 173-340-702(14)). At this time, the burden of proof requirements to demonstrate that no further cleanup is necessary have not been met. (BR)
17.	General	Provide in the document screening level benchmarks for soil, groundwater, surface water, and biota. The benchmarks should include cleanup levels based on WAC 173-340 (2001), and appropriate benchmarks for tissues. (BR)
18.	General	Environmental Protection Agency (EPA) guidance Region 10 Supplemental -1997 (EPA 910-R-97-005) states when assessing bioaccumulation of COCs, biota samples from at least 2 trophic levels should be evaluated to determine the site-specific bioconcentration and bioaccumulation rates. Explain where this is demonstrated in this document. (JV)
19.	General	Identify how & where the uncertainty of the remedial action work causing

Comment Number	Section, Page, Paragraph	Comment
		adverse ecological impacts was accounted for. (JV)
20.	General	Identify how & where the systematic sampling to determine population or community response studies was discussed. (EPA—540-R-97-006) (JV)
21.	General	Include text in the document indicating the nature of the toxicity testing, such as whether or not it addresses acute or chronic exposures and whether or not laboratory controls were involved; provide the types of laboratory controls. Please see EPA-540-R-97-006 Section 2.2.3.6. (JV)
22.	General	Explain in the document what is being done to ensure that when the additional sampling of tadpoles (and other biotic samples) occurs, there will be simultaneous sampling of the associated abiotic media so that samples will be spatially and temporally related. (JV)
23.	General	Explain in the document whether or not all operational sites were remediated to the levels required by WAC 173-340 (2001). (JV)
24.	General	When was fate & transport modeling of COPCs/COCs done? How was this correlated with site sampling data? (JV)
25.	General	How were field measurements (e.g. tissue residue levels) used to calibrate exposure & food chain models? How were exposure and food chain models correlated to the chemical COC/COPCs models and site data? (JV)
26.	General	Ecology expects the following information to be included in the document. Also, indicate in the comment disposition where the information can be located in the document: 1) Extent & location sites of contamination above thresholds for adverse effects. Provide figure. 2) COC/COPCs & their contamination levels, which may be exceeded in the future (i.e., after 150yrs, after 300years). 3) Half life of COC/COPCs in environments in this study & potential for natural recovery once sources are removed. 4) Macro invertebrate ingestion pathway data; including how soil contaminant concentrations were calculated. (JV)
27.	General	Throughout the document, it is stated that this is a baseline risk assessment when truly it is not. Please change the name of this document to something other than a baseline risk assessment. (JV)
28.	General	Data from the Inter Areas Shoreline Assessment represent a data gap for this assessment. The 100 and 300 Area component risk assessment is incomplete without it. Final decisions for the 100 and 300 area sites should not be made without consideration of the Inter-Areas Shoreline Assessment. This document should be revised to include the Inter-Areas component of the RCBRA. (JV)
29.	General	The document does not adequately address groundwater risks. (JV)
30.	General	Regarding contaminant gradients, guidance (EPA 540-R-97-006) states "If the gradient of contamination causes no impacts at the highest concentration or is one that kills everything at the lowest concentration, it would not provide useful exposure-response information. A gradient verification

Comment Number	Section, Page, Paragraph	Comment
		requires chemical sampling, but field screening-level analyses might be effective." Prior to this, the guidance states "If a contaminant gradient is necessary for the sampling plan, it is important to verify that the gradient exists and that the range of contaminant concentrations is appropriate." Explain by adding text to the RA document how the range of contaminant concentrations was verified and how it is appropriate. Because so much weight has been given to this approach, Ecology must be convinced that this was done correctly. (JV)
31.	General	Provide a discussion in the document about the condition (contamination/cleanliness) of reference sites. (JV)
32.	General	New data collected for this component of the RCBRA should be included in the HEIS database. The HEIS database is the database mandated by the Tri-Parties. (JAS)
33.	General	Sampling for macroinvertebrates/bivalves occurred in August. Is this the appropriate season for bivalve hatching, or would early spring and summer have been more appropriate for invertebrates? Explain why August was chosen. (JV)
34.	General	Final decisions based on this risk assessment need be considerate of the data from the Inter-Areas shoreline assessment. (JV)
35.	Executive Summary, General	The Executive Summary should be re-written after addressing all comments provided. The revised Executive Summary should be consistent with the revised document. (BR)
36.	Executive Summary, General	EPA guidance [EPA 540-R-97-006] states, "The ecological RA should provide information needed to make risk management decisions. A management option should not be selected first, and the RA tailored to justify the option." This document states that its purpose is to do risk assessment on remediated sites. The unspoken intent is to support the continued cleanup of the site with the current management option. It appears that this effort doesn't meet the expectations of EPA guidance. (JV)
37.	Executive Summary, General	How was the data from the 64 groundwater monitoring wells incorporated into the document? Please provide clarifying text in the Executive Summary and in the appropriate chapter in the document. (JV)
38.	Executive Summary, General	The definitions for the Hypothetical Recreational Use Scenarios do not appear to be provided in the main body of the document. Please include them in Chapter 5. If 'casual user' is the same as 'recreational visitor' please use just one of the terms. Was 'casual user' scenario included in exposures via fish & game meat? If not, why not? Please provide definitions for all of the other scenarios in Chapter 5 as well. (JV)
39.	Executive Summary, General	Provide rationale and justification for the development of 'a physically practical excavation and mixing model to estimate chronic surface soil exposure concentrations related to residual subsurface soil contamination.' (JV)

Comment Number	Section, Page, Paragraph	Comment
40.	Executive Summary, General	Regarding calculating potential groundwater-related risks with data from the 64 wells: Was potential risk calculated regarding the contaminant(s) effects on the surface waters? Add clarifying text to the Executive Summary. (JV)
41.	Executive Summary, General	Regarding risk to human health: Clarify what is meant by Hanford background (groundwater). (JV)
42.	Executive Summary, General	Briefly explain in the Executive Summary why potassium-40 & isotopes of radium & thorium were used while uranium was not used. (JV)
43.	Executive Summary, p. ES-1 and subsequent related description/analysis throughout the document	The document mentions risk related to the "potential transport of Hanford Site contaminants into Columbia River." The term potential should be differentiated from the current/existing and future contamination. It is not clear how future contaminant behavior is taken into account. It also fails to incorporate **uncertainties in these assumptions and related assessments.** (DG)
44.	Executive Summary, p. ES-1	Since this project is defined as a post - remediation baseline risk assessment covering a period of five years, more discussion needs to be added on how this decision was arrived at. Why is five years sufficient for the RI/FS workplan development? (JY)
45.	Executive Summary, p.ES-2, First bullet	According to the first bullet, the analysis is supposed to address risk "resulting from subsequent to implementation of the remediation action in 100 and 300 Area." According to this definition, it should include entire groundwater OUs of the River corridor NOT just the riparian zone as described in a number places (e.g. p 2-11, fist paragraph). Also, it is not clear what assumptions were used for these OUs as groundwater conditions after the implementation of interim remedial actions. Please clarify the scope and content of this assessment in simple language. (DG)
46.	Executive Summary, p. ES-1, 2nd paragraph	The RCBRA does not strictly fit the EPA definition of "baseline RA" (i.e., assumption of "no action"), since many of the waste sites have been remediated. Although this is explained later (e.g., p. 1-4), please reconcile here too. (DD)
47.	Executive Summary, p. ES-2, 2nd paragraph	Is there a written reference for this decision with the stakeholders and tribes to not endorse their exposure scenario? (JY)
48.	Executive Summary, p. ES-6, 2nd paragraph	Group #4 appears to be a subset of Group #2. (DD)
49.	Executive Summary, p. ES-6, 3rd paragraph	Risk from fish ingestion is likely due to both Hanford and non-Hanford contaminants. (DD)
50.	Executive Summary,	Are the sites listed in bullets the only sites where any risk was found or are there other sites? If there are others, list them too. (JV)

Comment Number	Section, Page, Paragraph	Comment
	p. 7, bullets	
51.	Executive Summary, p. ES-8, Table ES-1	With the exception of the last column (rads), please clarify if "RME Cancer Risk" includes only nonrad carcinogens or nonrad carcinogens plus rads. If nonrad and rad cancer risks are added, please discuss the uncertainty introduced by combining differences in risk factor derivation for nonrad carcinogens vs. rads. Ecology concurs with the following comment, initially made by Marc Stifelman (EPA): For cancer risks expressed as ">1E-02," use EPA's "one hit" equation (rather than the linear low dose equation) to estimate cancer risk (EPA, 1989) and specify result as a number (rather than as ">1E-02"). (DD)
52.	Executive Summary, Table ES-1, p. ES-8 – ES-9	Operational Area (No Excavation Soil-related risks) column not discussed prior to table. Include in the Executive Summary an explanation of how it is related to remediated sites or to reference sites and its purpose. (JV)
53.	Executive Summary, Table ES-1, p. ES-8 – ES-9	Explain in the Executive Summary (ES) why NA is applied to the Hunter and Casual Users. Also explain in the ES why NA is applied to a range of groundwater exposure risk for the Industrial User. (JV)
54.	Executive Summary, Table ES-1, p. ES-8 – ES-9	More explanation is required in the text for footnote (e). The footnote appears to be indicating that some of the times it's calculated correctly and other times it's not. Clarify. (JV)
55.	Executive Summary, Table ES-1, p. ES-8 – ES-9	Explain in the text if this table includes evaluations addressing concerns about recreational swimmers or those who drink water from the river. (JV)
56.	Executive Summary, p. ES-9, Table ES-1, footnote b	Please specify organic COPCs with elevated detection limits. (DD)
57.	Executive Summary, p. ES-10	Given the possibility of construction of facilities with basements below 15 ft (for instance a facility such as WTP) at sometime in the future, an intruder who excavates below 15 ft should be evaluated. (JV)
58.	Executive Summary, p. ES-10, 2nd paragraph	It is stated that background risks are calculated in two ways. The first way is via reference site risk, but the second way is unclear. Is the second way "Operational Area (No Excavation)" (third column in Table ES-1)? "Operational background" is an oxymoron. (DD)
59.	Executive	Six naturally occurring rads were not included. Provide text explaining why

Comment Number	Section, Page, Paragraph	Comment
	Summary, p. ES-11, last paragraph	risks associated with these radionuclides were calculated if they were not included. (JV)
60.	Executive Summary, p. ES-11, last paragraph	The statement about the fish ingestion pathway is unclear. What is meant by "an artifact of the calculated exposure point" and "inordinately affected by elevated detection limits" etc? It is not possible for the reader to determine if fish consumption is hazardous or not. Clarify please by adding text. (JV)
61.	Executive Summary, p. ES-12, 1st paragraph	It is stated that high risk for fish ingestion is an artifact of high detection limits for organics (e.g., PAHs and PCBs) and widespread levels of organics in Columbia River fish. Why is the latter (i.e., widespread levels of organics in fish) an "artifact?" (DD)
62.	Executive Summary, p. ES-12, 1st full paragraph	Rephrase the text to, "The ~~purpose of evaluating possible~~ groundwater-related risks results ~~is primarily to~~ provide an approximate measure of the relative significance of soil and groundwater as exposure media in the 100 and 300 areas." (JV)
63.	Executive Summary, p. ES-12, 1st full paragraph	Provide a figure of wells & identification of well HI values. (JV)
64.	Executive Summary, p. ES-12, 1st full paragraph	Provide text that identifies the protective biases inherent in the sweat lodge inhalation exposure pathway. (JV)
65.	Executive Summary, p. ES-12, 1st full paragraph	Explain in the text how the contribution of background to the risk calculations for the groundwater monitoring wells was so different than its contribution to the remediated waste sites. (JV)
66.	Executive Summary, p. ES-13, 1st paragraph	Regarding the last sentence, there are typically both conservative and nonconservative assumptions/uncertainties in risk assessment. Although many assumptions are conservative (protective bias), nonconservative toxicity, and exposure assumptions are also possible (e.g., incomplete COPC list, COPC synergisms, receptors/pathways/scenarios not considered). (DD)
67.	Executive Summary, p. ES-14, 2nd paragraph	A statement is made that assessment endpoints were developed from the ecological management goals, etc. This is not what EPA guidance directs for developing assessment endpoints (see EPA 540-R-97-006 and previous comment). Provide justification for this approach. (JV)
68.	Executive Summary, p. ES-14,	The purpose of this RA is stated to characterize potential adverse effects of residual post-remediation contamination. State in the text that this is not consistent with the purpose of a baseline risk assessment. (JV)

Comment Number	Section, Page, Paragraph	Comment
	2nd paragraph	
69.	Executive Summary, p. ES-15, 2nd paragraph	Weights for lines of evidence were not determined by consensus, as the text indicates. This was a controversial topic. (DD)
70.	Executive Summary, p. ES-15, bullets	Were assessments done on the "health" of species habitat; meaning was habitat preservation or disruption an assessment endpoint? Provide text that addresses this question. (JV)
71.	Executive Summary, p. ES-16, 3rd paragraph	Since upland plant toxicity tests were compromised, these bioassays should be repeated. (DD)
72.	Executive Summary, p. ES-16, Upland Terrestrial Plants	Risk conclusions are based on multiple lines of evidence. It is stated that field measures for plants show no difference between referenced and operational sites; however, the strongest most weighted line of evidence was lost (toxicity). Disagree with the conclusion. Provide justification for the statement about using a medium weighted line of evidence. (JV)
73.	Executive Summary, p. ES-16, Terrestrial Invertebrates	What is meant by COPCs detected in invertebrates does not correlate with abiotic media concentrations? Where was this abiotic media located? Lines of evidence were lost for terrestrial invertebrates and hazard indices were significantly different, so how can a conclusion of no adverse impacts be supported? Please provide text addressing these questions. (JV)
74.	Executive Summary, p. ES-16	The middle-trophic level duck species chosen did represent insect eating ducks but the species it was intended to represent eats plants. Please include text justifying the substitution of insect-eating ducks for plant-eating ducks. (JV)
75.	Executive Summary, p. ES-16	For middle-trophic mammals & carnivorous birds, riparian invertebrates, riparian middle-trophic level birds, middle trophic level mammals, and carnivorous birds please see comments in chapter 6 review; some of them dispute the assumptions presented here because of a loss or compromising of lines of evidence. Please modify the Executive Summary to provide text consistent with revised text in Chapter 6. (JV)
76.	Executive Summary, p. ES-17, 1st paragraph	Hand picking invertebrates not only "disabled estimates of relative abundance" but also compromised all invertebrate related measures (e.g., trophic transfer), as a result of nonrandom collection. (DD)
77.	Executive	Note that the invertebrate collection problem (i.e., hand picked nonrandom

Comment Number	Section, Page, Paragraph	Comment
	Summary, p. ES-17, 2nd paragraph	samples) may propagate to modeled dietary exposure (e.g., invertivorous birds). (DD)
78.	Executive Summary, p. ES-17, 3rd paragraph	Provide more detail on why middle trophic level mammals are a "focal taxon." Note that risk to small mammals is indicated by higher abundance and species richness at native soil references sites vs. native soil operational sites. (DD)
79.	Executive Summary, p. ES-17,3rd paragraph	The last sentence states that hazard indices are above 1 at all sites for small animals which is contrary to the first sentence of this paragraph where it states that overall risks are not indicated. Explain this discrepancy. (JY)
80.	Executive Summary, p. ES-18, 1st paragraph	Specify home range and area use factor (AUF) assumptions here. (DD)
81.	Executive Summary, p. ES-19, 1st paragraph	Since riparian plant toxicity tests were compromised, these bioassays should be repeated. (DD)
82.	Executive Summary, p. ES-19, 2nd paragraph	If riparian invertebrates were collected nonrandomly, associated measures are not statistically valid. (DD)
83.	Executive Summary, p. ES-19, 3rd paragraph	It should be noted that chemical, physical (e.g., temperature), and biotic stressors (e.g., nest predation) may combine to increase risk. (DD)
84.	Executive Summary, p. ES-20, 4th paragraph	Explain rationale for study boundary for near shore aquatic environment (i.e., 6 ft below low water mark). (DD)
85.	Executive Summary, p. ES-20 and ES-21	Please see comments in Chapter 6 regarding the near-shore aquatic plants and the Pakchoi lines of evidence, which were compromised. Also, provide justification for the statement that few macrophytes in operational areas are likely due to river flows, etc. This appears to be a data gap. (JV)
86.	Executive Summary, p. ES-21	Explain in the text how (if) grain size differs between aquatic stations. How do these sites compare to the reference sites in this regard? (JV)
87.	Executive Summary, p. ES-21, 2nd paragraph	Is the point here that small grain size with chromium contamination results in a high risk area for macro-invertebrates? (JY)
88.	Executive Summary,	Statements about HI for sediment-dwelling aquatic macro invertebrates being lowest in the chromium plume shoreline locations and bioassay results

Comment Number	Section, Page, Paragraph	Comment
	p. ES-21, Benthic Macro-Invertebrates	relationships are unclear. Please clarify. Also clarify how this is related to bioassay results and if they're related to strontium levels. (JV)
89.	Executive Summary, p. ES-21, 3rd paragraph	Provide rationale for the assertion that the influence of sediment grain size confounds growth and survival measures in benthic macroinvertebrates. (DD)
90.	Executive Summary, p. ES-21, 4th paragraph	Re benthic macroinvertebrates, a couple of articles on Se from ETC may be of interest (http://www.setacjournals.org/perlserv/?request=get-abstract&doi=10.1897%2F1551-5028%281997%29016%3C1255%3ASTTALA%3E2.3.CO%3B2; http://www.setacjournals.org/perlserv/?request=get-abstract&doi=10.1897%2F1551-5028%281997%29016%3C1260%3ASSTTAD%3E2.3.CO%3B2). (DD)
91.	Executive Summary, p. ES-22, 3rd paragraph	A statistically significant difference between 98% vs. 99.7% survival in operational vs. reference areas, respectively, implies extremely low variability in groups. Please clarify. (DD)
92.	Executive Summary, p. ES-22, Benthic Macro Invertebrate Associations with Pore Water	Were tissue evaluations performed on caddisflies? If so, provide reference to the data. Could the reason for total macro invertebrate diversity in the chrome plume also be due to effects of chrome? If so, please say so in text. (JV)
93.	Executive Summary, p. ES-22, Amphibians	Provide the following in the text: (1) How amphibian bioassays, while showing significant differences, are not likely ecologically relevant. (2) More details on initial pore water samples and how more representative samples were obtained. (JV)
94.	Executive Summary, p. ES-23	Fish: Explanation of the adverse effects is too confusing to follow. It appears that 6 out of 18 endpoints are adversely affected. Please revise/add text. Birds: Lines of evidence have been lost or compromised. This appears to be a data gap. See chapter 6 comments and add consistent text to the Executive Summary. Bats: Bats appear to represent a data gap. Delete text about antimony and selenium not being key groundwater plume contaminants. Eco Risk Summary: See chapter 6 comments on uncertainties listed in table 6-9, 6-10. Expand the list of uncertainties. (JV)
95.	Executive Summary,	Please clarify, "evaluates all receptors on a site-specific basis." (DD)

Comment Number	Section, Page, Paragraph	Comment
	p. ES-24, 1st paragraph	
96.	Executive Summary, p. ES-24, 2nd paragraph	Please provide attributes for assessment endpoints listed. (DD)
97.	Executive Summary, p. ES-24, 3rd paragraph	Note that plant toxicity test data were compromised for upland and riparian sites. This constitutes an uncertainty. Furthermore, there are always uncertainties in exposure (e.g., pathways) and effects (e.g., TRVs) in risk assessment that require more discussion than provided. (DD)
98.	Executive Summary, p. ES-24, 4th paragraph and p. ES-25	I would suggest moving this section on pipelines to the Human Health Risks section of the Executive Summary. It seems lost here. (DD)
99.	Section 1.0, p. 1-3, last paragraph	Change text, "Once a remedial action at a waste site is complete and the field screening and ~~confirmation~~ verification sampling indicate..." Confirmatory sampling usually refers to the process of identifying whether remediation is or is not required (i.e. confirmatory sampling is pre-remediation, not post-remediation). (JAS)
100.	Section 1.1, p. 1-2, 1st paragraph	When will the risk assessment be performed for groundwater contamination? Please clarify the scope of a groundwater risk assessment, since groundwater is being addressed in RCBRA to some extent (e.g., groundwater, seep, porewater samples). (DD)
101.	Section 1,1, p. 1-2, 2nd paragraph	Please provide a citation for "EPA guidance in Section 1.2.1." (DD)
102.	Section 1.1, p. 1-2, 3rd paragraph	EPA (1991f) has no Section 1.2.1. Please clarify. (DD)
103.	Section 1.1, p.1-2, 3rd paragraph and Section 1.2, p. 1-3, 1st full paragraph of pg	For number (1), include a list of the interim action RODs covering the River Corridor. Number (2), describes something other than a baseline risk assessment. EPA-910-R-97-005, pg. 5 states that baseline risk assessments are not intended to *document protectiveness* as stated, but simply to evaluate the site and to assist the decision making process for the final ROD. Consider re-naming this risk assessment effort to exclude the word baseline. (JV)
104.	Section 1.2, p. 1-3, Last paragraph of pg	Change the text at the beginning of the paragraph to read: "Once interim remedial actions were completed and the field screening and confirmation sampling indicated that interim cleanup goals were met...." The text describes how work was done in the past. However, decisions regarding the need for additional cleanup shall be based on the current regulations. (JV)

Comment Number	Section, Page, Paragraph	Comment
105.	Section 1.2, p. 1-3, Last paragraph of pg	Replace the last sentence of the paragraph with the following: "For radionuclides, the residual concentrations were evaluated using RESRAD modeling to demonstrate that the residual concentrations were protective of groundwater and the river." The existing statement is problematic because the methods used for establishing if cleanup was protective of the groundwater and surface water are in conflict with the methods required by WAC 173-340-747 (2001), especially with regard to alternate fate and transport modeling (WAC 173-340-747(8)) for nonraduclide contaminants. (BR)
106.	Section 1.4, p. 1-5, paragraph before bullets	In this paragraph reference a figure or map showing the geographical boundaries of this component of RCBRA. (BR)
107.	Section 1.4, p. 1-5, paragraph before bullets	The 100-N area is listed. Provide an explanation in the text regarding what sampling was performed for the RCBRA effort. (JV)
108.	Section 1.3, p. 1-4, bullet 4	A reference given for this bullet, DOE/RL-2005-37, is not listed in Section 7.0, References. Please add a reference for this document to Section 7.0. (JAS)
109.	Section 1.3, p. 1-4, bullet 4	The text states that the document focuses on "related groundwater plumes emerging in the near shore environment." This appears to be inconsistent with text on page 1-5 that states that inland groundwater plumes and plumes aligned with waste sites in the upland, riparian, and near shore zones were included in the scope. The scope of the groundwater assessment is not clear and it is not evident how groundwater wells were selected for evaluation. Please clarify in the text. (JAS)
110.	Section 1.4, p. 1-6, 4th paragraph	The text states, "The primary use of the risk assessment results, within the RI/FS process, is to determine risk and compare it with relevant standards to determine if a remedial action is warranted." It appears that only one of the CERCLA threshold criteria, protection of human health and the environment as risk, is being considered (and only partially) for determining the need for further cleanup. Compliance with ARARs, a second threshold criteria, is not being considered; the WAC 173-340 ARARs are risk based. The state requires compliance with WAC 173-340 cleanup criteria. Many of the sites will exceed current cleanup levels for protection of groundwater; i.e. they are not in compliance with WAC 173-340-747 (2001). These regulations will apply to final RODs in the 100 and 300 areas. Provide a comparison of all CVP, RSVP and RCBRA sites with current WAC 173-340-747 regulations to demonstrate that remediation can be considered complete. Address compliance with risk-based ARARs in this document. After adding the comparison to the document, include a reference to the comparison in #4, p. 1-7. (BR)
111.	Section 1.5.2, p.1-9, last	The 50 y period listed for long-term care is not consistent with the anticipated institutional control period generally assumed for the Hanford

Comment Number	Section, Page, Paragraph	Comment
	paragraph of page	site (150 y from present). Indicate in the text if the loss of institutional controls at 50 y was considered in RESRAD modeling and evaluations of protectiveness for the 300 areas. (JV)
112.	Section 1.5.2, p. 1-10, 4th paragraph	It appears that there is an inherent contradiction when combining conservation (e.g., protection of sensitive cultural and biological resources) with mining (e.g., access to geologic resources). Please reconcile. (DD)
113.	Section 1.5.2, p. 1-10, 4th paragraph	Is a mining scenario planned for future development in one of the risk assessments? (JY)
114.	Section 1.5.4.2, p. 1-14, 2nd paragraph	Exposure point concentrations (EPCs) for both human health and eco risk should use 95% UCL (e.g., see p. 29 in: http://www.epa.gov/nerlesd1/tsc/images/proucl4user.pdf). (DD) (BR) (JV)
115.	Section 1.5.4.3, p. 1-15, 4th paragraph	Please explain "ecologically relevant," re rationale for the 1 ha size of a terrestrial investigation area. (DD)
116.	Section 1.5.4.3, p. 1-15, 5th paragraph	I could not locate "Section 1.2.4, Field Sampling" in the SAP (DOE/RL-2005-42). Please clarify. (DD)
117.	Section 1.5.5, p. 1-17, 2nd to last paragraph on pg	Please provide text explaining why were there are only half as many reference sites as there were remediated sites. (JV)
118.	Section 1.5.5, p. 1-16, 2nd paragraph	"Section 1.2.5.1" (MIS study design) should be "Section 1.5.5.1." (DD)
119.	Section 1.5.5, p. 1-16 – 1-17, General	The MIS design focused on habitat while allowing site size and/or shape to vary. Provide a statistical basis for allowing MIS site size to vary. (JV)
120.	Section 1.5.5, p. 1-18, General	Text on this page is difficult to follow: suggest rewrite so reader can make better conclusions. Examples of areas of confusion that need clarification: Identify number of sample sites, which tissues were evaluated and when, why you think deeper water fish are more consumed by humans than near-shore and how this can provide upper bound for exposure to contaminants, why you chose gravel sizes you did and point of substrate baskets and tubes, where and why was histopathological and/or contaminant analysis done and why wasn't it done at all sites? (JV)
121.	Section 1.5.5.1, p. 1-19, 3rd paragraph	"Section 1.2.6" (MIS performance assessment) should be "Section 1.5.6." (DD)
122.	Section 1.5.5.1, p.1-19-20, MIS	This section is difficult to follow. The locations of MIS sites are unclear as well as the number of samples taken for each site; include whether it was a soil upland/riparian or whether it was aquatic near shore. Are samples taken consistently from site to site; are the same parameters evaluated?

Comment Number	Section, Page, Paragraph	Comment
		Clarify number of samples and sample sites. What are the 18 additional discrete samples for & how were the data used? (JV)
123.	Section 1.5.5.2, p. 1-20, MIS	Clarify how this section fits with the previous and subsequent sections. The text begins "The remaining 36 MIS sites were sampled between January and August." However, it is not clear which 36 were remaining (remaining relative to?); explain in the text where the 36 MIS sites are or their purpose. Suggest making a table for all specific sample matrices and including it in the text. The table should include site locations, number of sample taken, the sample date, the type of site, the type of sample (MIS or discrete). (JV)
124.	Section 1.5.5.2, p. 1-20, 5th paragraph	Re Table 1-1, due to sampling over a period of one year (Oct 05-Nov 06), relationships among variables may be somewhat obscured by different temporal regimes. (DD)
125.	Section 1.5.6, p. 1-20 – 1-21, 1st paragraph of section	Provide more details about MIS in this section. It gives some details (numbers of increments, depths, sieve size), but leaves out some critical ones, such as random placement of the grid and the use of a separate grid for each of the five MIS samples from each site. Even though these details are given in the DQO document, the reader would really benefit from having them here. (BR)
126.	Section 1.5.6, p. 1-21, 1st paragraph	Because the MIS performance assessment evaluated only 20% of the investigation areas, note that some degree of uncertainty is associated with conclusions which apply to all investigation areas. Please comment on the representativeness of the subsample of sites. (DD)
127.	Section 1.5.6, p. 1-21, 2nd paragraph of section	The text states "Contaminants that were not detected, and contaminants with concentrations less than quantification limits or Hanford site background, did not warrant further consideration in the statistical design." Ecology did not agree that non-detects and results below background could be omitted from statistical analyses. Ecology made the following comment on the MIS performance evaluation: Page 1, 4th paragraph. Delete the 4th sentence: "Contaminants with concentrations less than background/quantitation limits or much less than the cleanup level do not warrant further consideration in the statistical design." Since the appropriate cleanup levels were not used in the comparison, cleanup levels should not be criteria in this assessment. Also, since these are only 9 sites out of hundreds in the river corridor, it is too early to eliminate contaminants from consideration, and this was not the original intent of the performance assessment. The performance assessment was to focus on determining the number of MIS samples needed at the 1-ha plots." Ecology continues to require consideration of non-detects and values below background according to the approach agreed to for the Statistical Methodology summary discussed in phone conferences in November and December 2006. (BR)
128.	Section 1.6.1.1, p. 1-22,	The first bulleted item (EPA/540/1-89/001) is RAGS-Environmental (not Human Health). As such, it should not be included in this human health

Comment Number	Section, Page, Paragraph	Comment
	bullet 1	section. (DD)
129.	Section 1.6.1.1, p. 1-22, 2nd paragraph	Add March 2005 Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (EPA/630/R-03/003F) (http://www.epa.gov/iris/children032505.pdf). Also, add Sept 2006 Child-Specific Exposure Factors Handbook (EPA/600/R/06/096A). (DD)
130.	Section 1.6.1.2, p. 1-23, 2nd paragraph	Non-detected nonradionuclides should be included at half detect level if there is reason to believe these COPCs are present on site. Typically, non-detect radionuclides should be evaluated by using their reported result (i.e., a negative or positive number) when a numerical result is reported. (DD)
131.	Section 1.6.1.3, p. 1-23, 4th paragraph	Ecological impacts are specified in this section (1.6.1.3) which concerns human health only. Please delete eco impacts here. (DD)
132.	Section 1.6.2, p. 1-24	Looks like "Section 1.3.2.3" should be "Section 1.6.2.3." (DD)
133.	Section 1.6.2.1, p. 1-24, 4th paragraph	Add EPA 1993 Wildlife Exposure Factors Handbook (EPA/600/R-93/187a & b). (DD)
134.	Section 1.6.2.3, p. 1-25, Problem Formulation	Was "off-site" migration of COPCs/COCs and potential impacts considered during this RA process? Clarify. (JV)
135.	Section 1.6.2.3, p. 1-26, Risk Characterization	"Section 4.0" should be "Section 2.0." (DD)
136.	Section 1.6.2.3, p. 1-27, 1st paragraph	Please describe rationale for assigning low, moderate, and high weights to lines of evidence. (DD)
137.	Section 1.6.2.3, p.1-27, 5th bullet	Clarify what is meant by 'refined dietary exposure modeling.' (JV)
138.	Section 1.7, p. 1-28	How will the uncertainties in the Human Health risk assessment be addressed? (JY)
139.	Figure 1-1, p. 1-29	In the figure, the river corridor interim area covers 200-PO 1 groundwater OU containing contaminants nitrate, I-129, and tritium. The text does not cover adequately how these contaminants are addressed in this assessment. (DG)
140.	Figure 1-1, p. 1-29	Please identify the impacted areas of the Columbia River on this figure. (JV)
141.	Figure 1-2, p.1-30	Other than the river, the blue areas need a different color. Provide a legend for all colors. (JV)
142.	Section 2.1.1.2, p. 2-5 to 2-6,	Change sentence in all sections (100-B/C, 100-K, 100-N, 100-D, 100-H, 100-F) to reflect known contamination, "Contamination ~~may~~ also exists in groundwater along the Columbia River shoreline and near-shore river

Comment Number	Section, Page, Paragraph	Comment
		environment (where groundwater meets the surface soils), and Columbia River water." All of these areas have known groundwater contaminant plumes reaching the river. The text should identify the contaminants present in these plumes for each reactor area. (JAS)
143.	Section 2.1.1.2, p. 2-5, 4th paragraph	The text states that metals comprise a key contaminant plume. Please identify which metals are present in contaminant plumes in 100-N Area. (JAS)
144.	Section 2.1.1.2, p. 2-6, 2nd paragraph	The milestone for completion of remedial actions at the 100-H Area (M-16-51) was changed to December 31, 2011 (TPA Change Control Form, 6/26/2007). Please correct. (JAS)
145.	Section 2.1.4, p. 2-10, last paragraph	Change text, "Groundwater contamination is known to occur within the ~~water table~~ saturated zone underlying the Hanford Site." (JAS)
146.	Section 2.1.4, p. 2-11, 5th paragraph	The text references a very old document (EPA, 1996). Since that time, data collected indicates the presence of very high concentrations of organic contaminants, including TCE significantly higher than the drinking water standards in wells and aquifer tubes (PNNL-16345). Please update the text. (JAS)
147.	Section 2.2, p. 2-11, last paragraph	The text states, "Most precipitation that falls on the Hanford Site is lost through evaporation (PNL-10285). However, some precipitation infiltrates the soil..." The text subverts the information in PNL-10285. PNL-10285 states that natural recharge is significant in comparison to other groundwater inputs and is greatly increased in sandy soils (200 Areas) and in areas of disturbance, both of which comprise waste disposal areas. Additionally, the site receives most of its precipitation in winter when evapotranspiration is low. Change text to, "Precipitation that falls on the Hanford Site is lost through evapotranspiration or infiltrates into the soil and eventually recharges groundwater flow systems. Recharge is believed to be most significant in areas of disturbance that occur in and around waste disposal areas (PNL-10285). Moisture movement through the vadose zone...." (JAS)
148.	Section 2.1.4, p. 2-12, 3rd paragraph	Indicate the range of depths to groundwater in the 100 and 300 Areas. (JAS)
149.	Section 2.1.4, p. 2-13, 1st paragraph	Change text, "There is no longer artificial recharge due to waste disposal operations, as all liquid-generating processes have ceased." Some artificial recharge is still associated with site operations (e.g. leakage from water lines, reservoirs, dust suppression, etc). (JAS)
150.	Section 2.3.4, p. 2-20, 3rd paragraph	The text is inconsistent with PNNL-15892, Hanford Site Environmental Report for CY 2005 (Sept 2006). For species regularly occurring on the Hanford Site, PNNL-15892 lists two fish species on the federal list of threatened and endangered species, including spring-run Chinook salmon and steelhead. In addition, two plant species (Umtanum desert buckwheat and White Bluffs bladderpod), one mammal species (Washington ground

Comment Number	Section, Page, Paragraph	Comment
		squirrel), and one bird species (western sage grouse) are candidates for federal listing. Additionally, 12 plant species are listed as threatened or endangered by Washington State, whereas the text in Section 2.3.4 lists only eight plant species. Please correct the text and include these in the evaluation of threatened and endangered species. (JAS)
151.	Section 2.3.3, p. 2-18, 3rd paragraph	Provide rationale for the 2 m depth boundary of the near shore river environment. (DD)
152.	Section 2.4.1, p. 2-21, 5th paragraph	Re: remedial workers, I would note that these workers were excluded from the risk assessment by scope considerations (covered under a Site Health and Safety Plan) rather than because risks are controlled. Otherwise, it could be argued that risks are controlled at remediated waste sites, so these receptors should be excluded too. (DD)
153.	Section 2.4.2.1, p. 2-23, Last paragraph of page	The text cites and quotes WAC 173-340-740(6)(d). Please add the regulation date to the WAC citation. This is from the 2001 version of the WAC; the 1996 version of WAC 173-340-740(6)(d) instead covers cleanup at containment sites and monitoring. Because the 100 and 300 area cleanup activities have generally not applied the 2001 version of WAC 173-340, the year should be clearly indicated to the reader. (BR)
154.	Section 2.4.2.1, p. 2-24, 3rd paragraph	The text states that CVP data from below 15 ft are used to evaluate potential effects related to drill cuttings from a residential water supply well. It is not clear that the data exist to assess contamination associated with drill cuttings all the way to groundwater. Please clarify which data were used for this assessment. (JAS)
155.	Section 2.4.2.1 p. 2-24, last paragraph	The text dismisses the groundwater risk assessment stating that, "Exposure to groundwater is evaluated…However, the purpose of this risk assessment is primarily to evaluate the adequacy of soil remediation efforts at individual waste sites." Groundwater evaluation is a part of the human health risk assessment and should be fully evaluated. Please revise the text. (JAS)
156.	Section 2.4.2.1, P. 2-25, 1st paragraph	Modify the text as follows: Protection of groundwater from residual soil contamination was addressed <u>for interim remedial actions, using cleanup criteria from WAC 173-340 (1996)</u>~~, in the development of existing waste remediation critieria.~~ <u>Additional remedial actions may be necessary to comply with the requirements in WAC 173-340-747 (2001).</u> Groundwater is being addressed… As requested in a previous comment include in this risk assessment a comparison between WAC 173-340-747 cleanup criteria and the concentrations of contaminants left in the vadose zone as documented in CVPs and RSVPs. Use the default approach with WAC 173-340 equation 747-1 or Modified Method B (WAC 173-340-747(5)) when site-specific parameter values are available. Ecology previously made the following comment for the 100 and 300 area component of the River Corridor Risk Assessment Work Plan– bold text

Comment Number	Section, Page, Paragraph	Comment
		indicates the WAC 173-340-747 citation: **"This study must address the groundwater pathway, and comply with the requirements of WAC 173-340-747 and -705 (2001).** This is a risk assessment, and ingestion of drinking water in the river corridor is part of exposure scenarios such as the rural residential scenario. This pathway has not been addressed across the river corridor in a manner that is appropriate for a risk assessment for the whole river corridor. The results of this risk assessment will not be useful if this pathway is omitted." (BR)
157.	Section 2.4.2.1; p. 2-25, 2nd paragraph	The exclusion of indirect groundwater pathways (e.g., irrigated garden produce) should be noted in an uncertainty section. (DD)
158.	Section 2.4.2.1, p. 2-25, 3rd paragraph	The text does not identify how the 64 groundwater wells were selected for use in the risk assessment. The SAP (DOE/RL-2005-42) is also not clear on the selection criteria. Please identify these criteria. (JAS)
159.	Section 2.4.2.1, p. 2-26, 2nd and 3rd paragraphs	Please provide references for modeling outdoor and indoor air concentrations. (DD)
160.	Section 2.4.2.2, p. 2-27 and Figure 2.3, p. 2-41	This industrial scenario omits use of drinking water. This is not consistent with the industrial scenario in WAC 173-340 (see WAC 173-340-720), which includes drinking water in industrial areas. The document refers to a "future" industrial worker. There are no guarantees that future industrial workers will not use on-site drinking water. Also, Risk Assessment Guidance for Superfund (RAGS; EPA/540/1-89/002), Vol. 1, Part A, Exhibit 6-7 lists groundwater ingestion as a pathway for risk assessments for the commercial/industrial population. Please include this pathway in the evaluation. (BR)
161.	2-27, para 4, Section 2.4.2.2	Future resident monument workers may potentially be exposed to groundwater contaminants through ingestion, dermal absorption, and inhalation of volatiles. Please add this to the text. (JAS)
162.	Section 2.4.2.2, p. 2-27	Include drinking water ingestion at the residence in the future monument worker scenario. (BR)
163.	Section 2.4.2.3, p. 2-30, 6th paragraph	Using invertebrate contaminant data in modeling may be inappropriate, since invertebrates were not collected randomly (hand picked). (DD)
164.	Section 2.5, p. 2-31, 2nd paragraph	Note that external rad exposure does not require "contact" of ecological receptor and contaminated media (only proximity). (DD)
165.	Section 2.5.1, p. 2-33, 5th paragraph	Environmental media evaluated also included air (see Figure 2-5) in the riparian zone. (DD)
166.	Section 2.5.1, p. 2-34, bullet 4 and	Sources for external radiation are typically contaminated environmental media (e.g., soil, sediment, water, air), not contaminated biota. Furthermore, dose coefficients are available for soil, water, and air, but not typically for

Comment Number	Section, Page, Paragraph	Comment
	p. 2-35, bullet 3	biota. USDOE biota concentration guides (BCGs) incorporate internal dose from radionuclides inside the body, as well as external dose from soil, sediment, and water (not biota). (DD)
167.	Section 2.5.2, p. 2-36, 3rd paragraph	Receptors are not endpoints. A receptor plus an attribute comprise an assessment endpoint. (DD)
168.	Section 2.6, p. 2-38, 2nd paragraph	Text states that upland, riparian, and near shore river zones "are used to inform or predict conceptual exposure models for humans and the environment." These zones were primarily defined to facilitate performance of the ERA, not the human risk assessment. Please incorporate this perspective. (DD)
169.	Figure 2-3, p. 2-41	The distinction between solid and dotted horizontal lines is unclear. Please clarify. (DD)
170.	Figure 2-3, p. 2-41	It is unclear why ponds and retention basins do not have the same release mechanisms, receiving media, and source media as liquid effluent sites. For example, why is there no infiltration or release/impact to groundwater shown for ponds and retention basins? Please correct or clarify. (JAS)
171.	Figures 2-4 and 2-5, p. 2-41	Re: figure headings, "Ecological endpoints" are not receptors. Please replace "Ecological endpoints" with "Receptors." Endpoints are effects. (DD)
172.	Figure 2-7, p. 2-44	Re: the figure title, this figure does not describe assessment endpoints. Rather, the figure describes receptors which comprise feeding guilds. Please revise. (DD)
173.	Section 3.0, p. 3-1 to 3-16	It may be more appropriate to place Chapter 3 in an appendix, since it is largely supplementary input material to the RCBRA. (DD)
174.	Section 3.2, p. 3-4, 3rd paragraph	Add text to Section 3.2.3, para 3: "However, the second 5-Year CERCLA ROD Review issued in November 2006 (DOE/RL-2006-20), Issue 7, identified that additional ecological data are needed to assess shoreline impacts related to the diesel area. The associated action, Action 7-1, instructs the collection of these data." (JAS)
175.	Section 3.5.2, p. 3-8, 2nd paragraph	Add text (from WDOH/ERS-96-1101), "The net results from the survey support a conclusion that cobalt-60 contaminated particles…do not pose a significant human heath risk; however, WDOH recommended removal of such particles if found during the course of clean-up actions." (JAS)
176.	Section 3.6.2, p. 3-9, 3rd paragraph	The text indicates total chromium over 1,000 ppm. For these pipelines, hexavalent chromium should have been a contaminant of concern, which would have a much lower direct exposure clean-up level (2.1 ppm). Please indicate whether hexavalent chromium was included in and detected by analysis. (JAS)
177.	Table 3-1 p. 3-12 – 3-15	Footnote "a" states that "Potential Contamination" is "Based on actual analyses or river effluent pipeline sediment and scale"; however, Table 3-2 indicates that 100-H-34, 100-K-80, 100-N-77, and 100-N-80 have not been characterized. Please clarify. (JAS)
178.	Table 3-1,	The table lists the following text in the Potential Contamination column for

Comment Number	Section, Page, Paragraph	Comment
	p. 3-14, 100-NR-1 Operable Unit, Site 100-N-77	the 100-N-77 Site: "Received raw river water. Potential radioactive contamination from emergency discharges." Other sites within the table provide a list of specific contaminants, or list "none," if applicable. Please provide a list of specific potential contaminants for this site. (NSJ)
179.	Table 3-1, p. 3-14, 100-NR-1 Operable Unit, Site 100-N-80	The table lists the following in the Potential Contamination column for the 100-N-80 Site: None[b] [b] 100-N-80 river effluent pipeline contaminants are expected to be analogous to those of the 1908-NE outfall structure because the pipeline received the same effluent as the outfall structure. The 1908-NE outfall structure was closed out because none of the contaminants of potential concern had concentrations that exceeded protectiveness criteria (Energy Northwest 2004). In order for COPCs to be eliminated from the analogous 100-N-80 site, it must be demonstrated that the contaminants were not detected. The fact that none of the contaminants had concentrations that exceeded protectiveness criteria at 1908-NE, does not mean that none of them were detected. Please revise the table to list potential contaminants of concern for 100-N-80 to include the list that was used for the 1908-NE outfall structure. (NSJ)
180.	Section 4.1, p. 4-1	The text states, "Table 4-1 provides a summary of these data as well as other data used in the assessment that were not collected under the SAP." What guidance were other samples collected from, that weren't collected under the SAP? Please include the other guidance documents within the text. (NSJ)
181.	Section 4.1, p. 4-1, 3rd paragraph	Re: Table 4-1, discuss some of the limitations/uncertainties associated with combining data from a variety of projects/sources with variable data quality requirements (e.g., study design, COPC selection criteria, statistical analysis, analytical methods). (DD)
182.	Section 4.1.2, p. 4-3, 3rd paragraph	Re: Table 4-3, the reference, "(EPA 2002)," does not appear in the Reference list. (DD)
183.	Section 4.1.3, p. 4-3, 5th paragraph	Provide a reference for the >180 µS/cm criterion for groundwater specific conductance. (DD)
184.	Section 4.1.3, p. 4-4, 2nd – 3rd paragraphs	The text states that pore water tubes were deployed at 30 operational sites; however, Sample Event 1 was unsuccessful as indicated by specific conductance, Sample Event 2 was successful for some sites, and Sample Event 3 took place at a few of the sites to obtain enough water for target contaminants. It is difficult to determine from the text how many of the sites where pore water tubes were deployed were successfully sampled, which

Comment Number	Section, Page, Paragraph	Comment
		sites were not successfully sampled, how many of each type of site (i.e. chromium, strontium, etc) were or were not sampled, and how sampling deviated from the SAP. Please clarify in the text or by a table. (JAS)
185.	Section 4.1.3, p. 4-4 and Figures 4-7, 4-11, 4-32, 4-62, 4-74, 4-86	From the figures, concentrations of contaminants (chromium, strontium, uranium) are consistently lower in pore water tubes versus aquifer tubes. Given, the problems encountered with dilution of pore water samples during sampling (pg. 4-4), what is the confidence that the pore water samples represent true contaminant concentrations? The SAP indicates that for purposes of comparison, locations where aquifer and pore water tubes exist will be sampled. Please include the comparison and any conclusions in the text. (JAS)
186.	Section 4.1.4, general	It is not clear from the text why reference sites are not discussed or used for comparison to groundwater data. This seems to diverge from the methodology used to evaluate the soil data. Please clarify. (JAS)
187.	Section 4.1.4, p. 4-4, 5th paragraph	Note that reference site selection involves two potentially conflicting goals: reference sites should resemble waste sites as closely as possible (except for contaminants) and be independent of the waste site with no exchange of biota (Suter et al, 2000). In most cases, reference sites that resemble waste sites most closely are those that are nearby, but these are least likely to be independent of the waste site. (DD)
188.	Section 4.1.4.2.1, p. 4-7, 2nd paragraph	Although use of borrow pits as reference sites may achieve a similar level of disturbance as remediated backfilled waste sites, the type of disturbance (i.e., excavation vs. backfilling) varies considerably (e.g., in soil properties) and confounds comparisons. (DD)
189.	Section 4.2, p. 4-9, 2nd paragraph	Please list criteria established to generate a hierarchy of data sources. (DD)
190.	Section 4.2, p. 4-9, 2nd paragraph	What is the reason for deleting duplicates? Duplicates are taken from the same source and analyzed by the same method. Is this a discussion of method preference? (JY)
191.	Section 4.2, p. 4-9 – 4-10, General	This section refers to a hierarchy of data sources. Please give the hierarchy of data sources in the text. Also, include text that defines "preferred data source." (BR)
192.	Section 4.2.1, p. 4-10, 1st paragraph	All data sources should be used if the data is QA/ QC defensible. What do you mean by overlap? (JY)
193.	Sections 4.2.1, 4.2.2, 4.2.3, p. 4-10	The text refers to "overlap" of data. It is unclear what this means, please clarify in the text. (JAS)
194.	Section 4.2.6, p. 4-11, General	The text does not discuss background values for groundwater or indicate what criteria will be used to evaluate groundwater data. Please include in the text. (JAS)
195.	Section 4.2.6,	Modify the last sentence as shown: At the time, the WAC definition of soil

Comment Number	Section, Page, Paragraph	Comment
	p. 4-11, 2nd paragraph of section	background was "...the mean value of the background population...", ~~which meant that 50% of all natural background could be misinterpreted as contaminated~~. The last portion of the statement (strike-out) is only true when the mean is equal to the median. Since this is often not the case, the statement is generally not correct. (BR)
196.	Section 4.2.6, p. 4-11 – 4-12	Add to this section or a chapter devoted to background, a discussion of how samples were collected and analyzed to establish background concentrations. Reference to DOE/RL-92-24 is not sufficient; however, a short paragraph is probably sufficient. The reader will need to compare the background determination methodologies with those used to collect the new data for this risk assessment. (BR)
197.	Section 4.2.5, p. 4-11, 3rd paragraph	"Table 4-2" should be "Table 4-4." (DD)
198.	Section 4.2.7, p. 4-12 – 4-13	The text states "...for all but plutonium-239/240, the maximum value was reported for the area background. This latter observation is expected because the reference site samples are multi-increment soil samples that represent the mean concentration for each investigation area. A more relevant comparison is the median area background concentration to the upland reference site concentrations, which are similar." Does this statement mean to tell the reader to compare median means for the MIS samples to medians for the area background samples? Please re-write these sentences to clarify. Provide a reference or further explanation supporting why comparing medians is more relevant. (BR)
199.	Section 4.2.6, p. 4-12, 3rd paragraph	Re: DOE/RL-92-24 (soil nonrad Hanford background document), text and Table 4-4 read "Rev 4," while References list "Rev 3." Please reconcile. (DD)
200.	Section 4.2.7, p. 4-12, 5th paragraph	Re: Table 4-5, add footnote to indicate reference site samples are MIS. Re: Figure 4-2, there was no symbol key initially, but it was later added. However, it is not clear if min, median, and max means represent min, median, and max MIS means of individual upland and riparian reference sites or pooled upland and riparian reference sites. Please clarify. (DD)
201.	Section 4.2.7, p. 4-13, 1st paragraph	Ecology's background document WDOE-94-115 averaged all of the samples including splits and duplicates. The 90th percentile was used. Why is the use of the median value more relevant? (JY)
202.	Section 4.3, p. 4-13	The text states, "A COPC is a detected analyte that is associated with Hanford Site operations." What about the non-Hanford operational contamination that may be present via off-site waste? If detected, they must be considered also, and carried forward for evaluation within the RCBRA. Please review all detected results for contaminants which were not identified as Hanford Site operations contaminants. (NSJ)

Comment Number	Section, Page, Paragraph	Comment
203.	Section 4.3.1.1, p. 4-13, 4th paragraph	Because historical data were not evaluated against the RCBRA/SAP, these data introduce data quality uncertainty into the assessment which should be acknowledged. (DD)
204.	Section 4.3.1.1, p. 4-14, 1st paragraph, and p. 4-16, 3rd and 4th paragraphs	What does a method detection level have to do with uncertainty in a risk assessment? If the data is defensible it is not uncertain and should be used to assess risk. (JY)
205.	Section 4.3.1.1, p. 4-14, 1st paragraph	Are all J qualified data being used? (JY)
206.	Section 4.3.2.1, p. 4-14, 4th paragraph	Re: usability code #15 in Table 4-6, why not convert molar units to mass units via MW? (DD)
207.	Section 4.3.4, p. 4-16, 3rd paragraph	The text states, "There are approximately 101,410 reported values in the RCBRA dataset." Does this number include the 54,979 results that have been considered unusable in Table 4-6? (NSJ)
208.	Section 4.3.6, p. 4-17, 3rd paragraph	Please explain the basis (e.g., provide a numerical example) of the 3 y half-life criterion to exclude short-lived rads. Also, why are only Tables 4-18 thru 4-20 (only sediment) called out here? (DD)
209.	Section 4.3.6, p. 4-18, 2nd paragraph	Because crystalline silica inhaled in the form of quartz is a known human carcinogen, silica in this form via an inhalation pathway should not be excluded. (DD)
210.	Section 4.3.7, p. 4-18, 4th paragraph	"Tables 4-11 through 4-20" should read "Tables 4-11 through 4-16." (DD)
211.	Section 4.3.7, p. 4-18 – 4-21	This section gives statistical tests for comparing background and reference sites, such as slippage tests and shift tests. However, it does not tell the reader why these tests were selected. If this is explained elsewhere in the document include a reference to the location in the document where the reader will find the explanation. Otherwise, add the explanation here. (BR)
212.	Section 4.3.7.1, p. 4-19, 1st paragraph	It is not clear why statistical tests cannot be performed on the groundwater data. Even though the original background results could not be obtained, statistics should be performed using the available summary statistics from the background data. (JAS)
213.	Section 4.3.7.1, p. 4-19, 3rd paragraph	Looks like "Tables 4-12, and 4-14 through 4-20" should read "Tables 4-14 through 4-16." Also, re: Table 4-12, the example in footnote "d" appears to be in error. Re: multiple comparison tests (nonparametric Tukey) in Table 4-12, was a statistical adjustment (e.g., Bonferroni) applied to control the overall Type I error rate (Stevens, 1986; Suter, 1996)? Re: Tables 4-13 through 4-16, it looks like table titles have a typo: "of" should be "or."

Comment Number	Section, Page, Paragraph	Comment
		(DD)
214.	Section 4.3.7.1, p. 4-19, 5th paragraph	"Table 4-12" should be "Table 4-13." (DD)
215.	Section 4.3.7.1, p. 4-20, 3rd paragraph	For logic flow, this information on Kruskal-Wallis tests should be presented earlier on p. 4-18 where Table 4-12 was first introduced. (DD)
216.	Section 4.3.7.2, p. 4-20 – 4-21, 3rd paragraph of section	The text states, "A total of 39 analytes were retained as different from RCBRA reference sediments based on distribution shift tests. Of those 39 analytes, only one was retained because there are no reference data for comparison and 10 were identified by uncertainty analysis as infrequently detected analytes that were different from reference." Which one was retained? What is meant by "no reference data for comparison"? Does this mean that the other analytes were not measured at the reference sites? Please clarify and provide in the text an explanation of the exclusion process for the analytes. Ecology cannot currently accept this elimination process. (BR)
217.	Section 4.4, p. 4-21, 4th paragraph	Are "paired biotic and abiotic media" paired in both space and time? Ideally, both are needed to identify relationships in a dynamic system. (DD)
218.	Section 4.4.2, p. 4-22, 5th paragraph	The text states, "Hexavalent chromium was detected only in aquifer tubes and pore water samples." However, Figure 4-11 "Box Plot of Hexavalent Chromium in Water" indicates detections of hexavalent chromium in aquifer tubes, pore water samples, seeps, and surface water. Please correct or clarify in the text. (JAS)
219.	Section 4.4.2, p. 4-22, 5th paragraph	The text states, "Chromium as a contaminant in Hanford Site groundwater is primarily in the hexavalent form; it is noted that in some cases total chromium is measured and reported, and in other cases hexavalent chromium is measured and reported." The figures for this section (Figures 4-4 to 4-28) evaluate total and hexavalent chromium separately, but without distinguishing between filtered and unfiltered total chromium. The groundwater project has been using total chromium (filtered) to represent hexavalent chromium concentrations. As a result, for water samples, three different sets of data should be evaluated - hexavalent chromium, total chromium (filtered), and total chromium (unfiltered), since these three methodologies represent different chemical components of the sample. (JAS)
220.	Section 4.4.2 , p. 4-23, 2nd paragraph, Chromium	Change text, "Because hexavalent chromium was not detected in media other than water (i.e. sediment)…". As written, the text implies that hexavalent chromium was not detected in biota tissue; however, this analysis was not performed. (JAS)
221.	Section 4.4.2, p. 4-23, bullets, Strontium	The text does not include a bullet for the discussion of strontium-90 detection in seeps. Please include this in the text. (JAS)

Comment Number	Section, Page, Paragraph	Comment
222.	Section 4.4.2, p. 4-22-4-23	This section discusses aquatic media but does not define/describe aquifer tubes, pore water, seeps, and the collection approach for surface water. Add a few sentences to help the reader understand the differences between these media types. Also, collection methods should be described briefly for sediments, macroinvertebrates, plants, clams, and fish. If they are given elsewhere in the document, please refer the reader, in this section, to the appropriate section of the document. Please do not ask the reader to go to another document for the definitions. (BR)
223.	Section 4.4.2, p. 4-23, 3rd paragraph	"Figures 4-24 through 4-32" should be "Figures 4-12 through 4-17 and Figures 4-22 through 4-24." (DD)
224.	Section 4.4.2, p. 4-25, bullet 1	Typical units for total U in surface water are mg/L, not mg/kg (e.g., Figure 4-50). (DD)
225.	Section 4.4.2, p. 4-25, bullet 2	Units for total U in pore water here should be mg/L, not µg/L (e.g., Figure 4-50). (DD)
226.	Section 4.4.2, p. 4-25, bullet 3	Looks like max total U in seeps is about 0.6 mg/L, not "29.8 mg/kg" (Figure 4-50). (DD)
227.	Section 4.4.2, p. 4-25, Surface water	The concentration for total uranium in surface water is given as a range from 0.0002 mg/kg to 0.116 mg/kg. Please check the units. Are these supposed to be mg/L? Correct if necessary. (BR)
228.	Section 4.4.2, p. 4-26, last sentence for sediments	The text states "All other detected concentrations of uranium-238 were less than 2.5 pCi/L." Are the units correct? The rest of the paragraph uses units of pCi/g. Please correct. (BR)
229.	Section 4.4.2, p. 4-26, bullet 1 (fish)	Total U in fish is non-detect (by Figure 4-58) but was detected in 27.7% of fish samples (by Table 4-23). Please reconcile. Text and Figure 4-66 indicate that U-233/234 was not detected in fish, but Table 4-23 indicates a 27.7% detect rate. Please reconcile. Figure 4-82 indicates that U-235 was not detected in fish, but text and Table 4-23 indicate an 8.5% detect rate. Please reconcile. Figure 4-94 indicates that U-238 was not detected in fish, but text and Table 4-23 indicate a 26.9% detect rate. Please reconcile. (DD)
230.	Section 4.4.2, p. 4-26, bullet 2 (clams)	Units for total U in clams are mg/kg, not pCi/g (Figure 4-58). (DD)
231.	Section 4.4.2, p. 4-26, bullet 3 (macroinverts)	Units for total U in macroinverts are mg/kg, not pCi/g (Figure 4-58).(DD)
232.	Section 4.4.2, p. 4-26, 2nd paragraph	Regarding linear regressions in Tables 4-24 to 4-26, was a statistical adjustment (e.g., Bonferroni) applied to control the overall Type I error rate? These "significant regressions" could be expected by chance alone (Stevens, 1986; Suter, 1996). Also, in general, the r^2 values are relatively low,

Comment Number	Section, Page, Paragraph	Comment
		indicating that only a small part of the variance in COPC tissue concentration is explained by the fitted regression. Why is "n" so small for Hg (Table 4-24) and Sn (Table 4-25)? (DD)
233.	Section 4.4.4, p. 4-27, general,	As provided, the time trend plots are not meaningful to the reviewer. It is difficult for the reviewer to interpret groundwater trends without knowing which wells are being discussed (i.e. well name) and understanding the regime in which these wells operate. For example, many of these areas contain pump and treat systems including extraction and injection wells that affect contaminant concentrations in the monitoring wells. There are also river stage effects that affect contaminant concentrations. Without understanding these effects, knowing the location of the wells, and understanding how and when these wells were sampled, it is difficult to draw conclusions from the data. It would be helpful if the text would provide interpretations of any observed trends. (JAS)
234.	Section 4.4.4, p. 4-28, 2nd paragraph	Please specify that uranium in Figures 4-124 to 4-127 is "total uranium" (if this is the case). (DD)
235.	Section 4.5.2, p. 4-29, 2nd paragraph	Regarding Figure 4-128, please add MVUE to figure legend key and complete sentence on Shapiro Wilk test. (DD)
236.	Section 4.5.3, p. 4-30, 5th paragraph	Regarding Table 4-28 "All Detects [N=3,4]" and "All Detects [N≥5]," why is the max value used for UCL in some cases for biota, soil, and water? This is inconsistent with Figure 4-128. Regarding Table 4-28 "Value" column, why is "All Non-detects" listed? Does this imply that no representative concentration was calculated? If so, this is again inconsistent with Figure 4-128. (DD)
237.	Section 4.6, p. 4-30, 6th paragraph	Please note that because dosimeters measure only gamma emitters, this is not the complete external dose (i.e., beta emitters contribute to external dose too). (DD)
238.	Section 4.6, p. 4-31, 2nd paragraph	Specify the statistical test used to evaluate external dosimetry across sites (upland, riparian) and categories (operational, reference). (DD)
239.	Section 4, Figures showing concentration by HRM	Please include labels on the x-axis (hrm) of these figures indicating the locations of the reactor areas. This would help with interpretation of the data. (JAS)
240.	Chapter 4 figures, general	Several figures are box plots showing reference and operational areas. These figures may lead readers to make comparisons between reference and operational areas as if the two should be compared statistically. However, the judgmental nature of sampling makes such comparisons questionable. Judgmental sampling is done on the premise that worst case locations are identified and included. It does not have a statistical basis. In these cases, consideration of the high outliers becomes important. For example, on

Comment Number	Section, Page, Paragraph	Comment
		Figure 4-20, the high sediment chromium concentrations cannot be overlooked – they exceed cleanup criteria for soil, suggesting that there should be remedial action in the locations with the high detects. (This is also true for uranium, for example on Figure 4-90). Ecology has consistently requested statistically-based sampling. Ecology previously had the following comment about the statistical methodology when provided in an early draft form: "In cases where hot spots are suspected, OSWER 9285.6-10 (p. 3, para 3, http://www.hanford.gov/dqo/training/ucl.pdf) recommends stratified random sampling (not simply, "statistical analyses based on stratification") in order to avoid mixing of samples across different populations. As the Neptune response notes, the assumption of random sampling applies to all methods described in this OSWER guidance for calculating UCL (including bootstrap). Therefore, if sample collection is not conducted randomly, this should be acknowledged as a source of bias in EPC estimates. (DD)" Please include an explanation in Chapter 4 that tells the reader how to use the box plots and point out that the sediment sampling approach did not have a statistical basis; discuss the importance of the high values in the context of judgmental sampling. (BR)
241.	Figure 4-2, p. 4-34	Please add a key for the symbols. (BR)
242.	Figure 4-6, p. 4-10 and all figures in Chapter 4 with NA	Provide an explanation for NA in the legend or re-label the data to make this category clear. (BR)
243.	Figure 4-9, p. 4-38	The figure shows extremely high concentrations of hexavalent chromium in the BC area in aquifer tubes as recently as 2004. It also appears that surface water may exceed the 10 µg/L criterion. It is curious that the aquifer tubes used in this study did not capture Cr(VI) in any of the downstream areas including D area. Discuss this aspect in the text. (BR)
244.	Figure 4-12, p. 4-40 and Figure 4-15, p. 4-41	The figures show that macro-invertebrate chromium is not high where pore water Cr is high. Discuss in the document the macro-invertebrate presence/absence at river mile 10. Also discuss possible explanations for the higher Cr tissue concentration at river mile 5 than elsewhere. (BR)
245.	Figure 4-28, p. 4-48	It is not clear in this figure if periphyton and milfoil are included as aquatic vegetation. Please add text in the document to address periphyton and milfoil. Periphyton and milfoil have some of the highest concentrations of metals amongst the biotic media in the GiSdT database. (BR)
246.	Figures 4-118 – 4-127, p. 4-99 – 4-103	The symbols in the figures are not clearly described. The note "Markers denote different sampling locations in proximity to the HRM listed on the y-axis" is hard to interpret. Please provide a clear legend for the symbols. (BR)
247.	Table 4-2, p. 4-108,	The table states that method 8270A is needed to evaluate the risk from TPH constituents. However, no upland/riparian tissues or near-shore aquatic

Comment Number	Section, Page, Paragraph	Comment
	Indicator Contaminants column, 10th row	tissue samples appear to have been tested for TPHs (i.e.; method 418.1, WTPH-G and WTPH-D). If it is necessary to determine the risk from TPHs, then TPHs should have been analyzed. Please explain why no samples within Table 4-2 were tested for TPH contamination. (NSJ)
248.	Table 4-6, p. 4-115, Count of Results column	In order to make this information more useful and clear, the "Count of Results" needs to be expanded to list how many actual "samples" were affected by the specified number of unusable results. For example, the 8,482 results that were categorized with a "6" Usability Code, came from "X" number of samples. Since many analytical methods are capable of detecting several different constituents, the term "results" can be interpreted in different ways. Were 8,482 samples categorized with a 6 Usability Code, or were 8,482 constituents categorized with a 6 Usability Code? Please also provide what types of samples were affected for each Usability Code (i.e.; tissue, soil, all types, etc.). Also, list what percentage of the total sample population for the RCBRA have been categorized into each Usability Code (i.e.; Not-Usable for the RCBRA). (NSJ)
249.	Table 4-6, p. 4-115, Usability Code 2	425 results have been categorized as Usability Code 2. This code is described as being a method used for analysis was inappropriate for the analyte evaluated. Define how the term "inappropriate" is being applied. Does it mean that the method used was not approved in the Sampling and Analysis Plan? Since laboratories are instructed as to which methods to use for analyzing the project supplied samples, why were so many inappropriate methods requested by the project? Please provide a more complete description which defines the inappropriate use of analytical methods within the text. (NSJ)
250.	Table 4-6, p. 4-115, Usability Code 6	8,482 results have been categorized as Usability Code 6. This code pertains to the results from the 100-B/C Pilot Project that were mathematically decayed to the analysis dates for that project. Decayed results are not applicable to RCRBA. It is possible to re-calculate decayed results back to the undecayed, original values? Please do so, and make the 8,482 100-B/C Project results usable for the RCRBA. (NSJ)
251.	Table 4-6, p. 4-115, Usability Code 7	207 results have been categorized as Usability Code 7. This code pertains to data qualified as "R" by laboratory, reviewer, or validator. Do any of these 207 results duplicate any of the 425 results that have been categorized with Usability Code 2 (Inappropriate analytical method)? (NSJ)
252.	Table 4-6, p. 4-115, Usability Code 8	6,098 results have been categorized as Usability Code 8. This code pertains to missing units of analytical results. Investigating the data package more thoroughly could result in determining the missing units. Please re-evaluate these 6,098 results by reviewing the

Comment Number	Section, Page, Paragraph	Comment
		pertinent data packages or by contacting the analytical laboratories which provided the results. (NSJ)
253.	Table 4-6, p. 4-115, Usability Code 9	1,029 results have been categorized as Usability Code 9. This indicates that the result is for a laboratory equipment blank, not RCBRA investigation sample. Why was this category necessary? Weren't these 1,029 laboratory equipment blanks properly labeled as such? If they weren't mislabeled, then this Usability Code should not be needed. However, if these equipment blanks were improperly labeled as samples, state this in the Usability Code description. In addition to that, please be prepared to provide evidence that improper labeling of the laboratory equipment blank occurred. (NSJ)
254.	Table 4-6, p. 4-115, Usability Code 11	15,897 results have been categorized as Usability Code 11. This indicates that the sample has another result for the same analyte using a more preferred analytical method. 15,897 samples are a tremendous amount to be basically double analyzed by a project. Please provide a few specific examples of when this occurred. Also, are any of there samples also categorized into Usability Code 2 (inappropriate analytical method)? (NSJ)
255.	Table 4-6, p. 4-115, Usability Code 12	9 results have been categorized as Usability Code 12. This indicates that the lab was not authorized to perform this analysis for Hanford samples. This is interesting, since laboratories only do the analyses that have been requested of them by the project who supplied the samples. Furthermore, were there any QA/QC issues with these 9 samples, or is the data usable? If no quality issues were found, the results should be evaluated by the RCBRA. (NSJ)
256.	Table 4-6, p. 4-116, Usability Code 13	7,672 results have been categorized at Usability Code 13. These results are considered not usable because they are ISRM treatment samples. The detailed description states that the result is reported treatment for ISRM injection well. The result not comparable to groundwater monitoring or sample data. This description is confusing. Please revise the text to improve clarity. (NSJ)
257.	Table 4-6, p. 4-116, Usability Code 15	1,013 results have been categorized as Usability Code 15. This indicates that the reported results are in molar units, and therefore not useable for the risk assessment. It should be possible for these results to be converted from molar units to usable units, if the necessary sample information is obtained from the data reports (i.e., sample size, dilution, etc.) Please re-evaluate these 1,013 samples and provide justification for ones any which cannot be mathematically recalculated. (NSJ)
258.	Table 4-6,	7,036 results have been categorized as Usability Code 16. This indicates

Comment Number	Section, Page, Paragraph	Comment
	p. 4-116, Usability Code 16	that the result was reported by more than one data source. Results from preferred data source was retained as usable in the database. Please explain how Usability Code 16 is different from Usability Code 11. (#11: Analytical results for analyte generated by more than one method. Preferred method is retained in the database.) Do any of the 7,036 results in Usability Code 16 duplicate any of the 15,897 results categorized into Usability Code 11? (NSJ)
259.	Table 4-6, p. 4-116, Usability Code 19	36 results have been categorized as Usability Code 19. This indicates that there is uncertainty due to ongoing investigation. This description is unclear. Please provide a more detailed description within the text. (NSJ)
260.	Table 4-6, p. 4-116, Usability Code 23	988 results have been categorized as Usability Code 23. This indicates that the sample has another result for the same analyte with more complete information. This description appears to be similar to Usability Codes 11 and 16. Please explain the redundancy. (NSJ)
261.	Table 4-6, p. 4-116, Usability Code 24	1,480 results have been categorized as Usability Code 24. This indicates that the sample has an identical result for the same analyte. Why were so many samples double-analyzed for this project? (NSJ)
262.	Table 4-6, p. 4-116, Total	The table shows that a total of 54,979 results have been categorized as unusable. What percentage is this of the total data population of the RCBRA? (NSJ)
263.	Table 4-8, p. 4-118	As an observation, there is justification for including PCBs in the risk assessment. PCBs were detected in MIS samples. This is evidence that these constituents are important in the River Corridor. There is more evidence from CVP/RSVP detects listed on Table 4-9, and the exceedance of background values given on Table 4-13. Retain PCBs in the risk assessment. (BR)
264.	Chapter 5, General	Ecology requires evaluation of Unrestricted Use as defined in WAC 173-340 (2001). For soils, refer to WAC 173-340-740, and -720 for groundwater. Add this as a risk scenario. Include the parameters on Table 5-8. For some of the parameters refer to previous Ecology comments for the Human Health Risk Calculations handout provided in November 2006: "Consistent with WAC 173-340-740, equations 740-1 and 740-2, Ecology will use results based on soil ingestion rates of 200 mg/kg, exposure frequencies of 365 days/y, and child body weight of 16 kg, or values more conservative than these. WAC equations 740-1 and 740-2 use parameters for children – in combination these yield more conservative results than adult parameters." "Consistent with WAC 173-340-750, equations 750-1 and 750-2, Ecology will use results based on inhalation rates of 10 m^3/day (noncarcinogens) and 20 m^3/day (carcinogens), exposure frequencies of 365 days/y, and child

Comment Number	Section, Page, Paragraph	Comment
		body weight of 16 kg, or values more conservative than these. For noncarcinogens WAC equation 750-1 uses parameters for children – in combination these yield more conservative results than adult parameters. However, for carcinogens (WAC equation 750-2) the adult parameters (including a breathing rate of 20 m^3/day) yield more conservative results than the child parameters." "The text states 'In Section 3.2.2.4 of this guidance, EPA recommends that absorption of metals from soil not be quantified with generic ABS_{GI} values if a metal-specific value is unavailable. Therefore, dermal absorption from soil is only quantified for those metals for which EPA provides a value in Exhibit 3-4. Also in accord with EPA guidance (2004), dermal absorption of VOCs from soil is not quantified.' These statements are not consistent with WAC 173-340-740 equation 740-4, for which the default ABS_{GI} value is 0.01 for inorganics; for organics with a vapor pressure > benzene's v.p. the default value is 0.0005. WAC 173-340 requires in general that more conservative values be used when available, so the specific values given above can be replaced with more conservative values. However, total omission of contaminants is not consistent with WAC 173-340." "For a soil adherence factor Ecology will use results based on a value of 0.2 mg/cm^2, consistent with Equations 740-4 and 740-5 in WAC 173-340." "Ecology will use results calculated with the default values in Equations 740-4 and 740-5 in WAC 173-340, or more conservative values when available. Many of the values in Table 13 are less conservative than the WAC 173-340 default values." "The RME value given for water ingestion for children is 0.9 L/day. To be consistent with WAC 173-340-720 Equation 720-1 Ecology will use results calculated with drinking water ingestion rates of 1 L/day for noncarcinogenic chemicals, along with other child exposure factors including EF of 365 days/y and BW of 16 kg." (BR)
265.	Section 5.2.1, p. 5-2, General	An alternative to the problem of including every exposure scenario of interest is to use a "unit dose/risk" approach, in which all exposure pathways are identified, a dose/risk per unit exposure parameter is calculated, and then a spreadsheet is provided where the exposure parameters for each pathway can be entered and the total dose calculated. For example, determine the dose/risk per gram of fish ingested, the dose/risk per gram of soil ingested, the dose/risk per hour for external radiation, etc… and include these values on a spreadsheet; then the user can enter the number of grams of fish ingested per year, the number of grams of soil ingested per year, the number of hours spent on the site per year, etc…; and finally the spreadsheet will calculate the total dose/risk. This idea eliminates the need to have agreement on exposure scenarios. (SV)
266.	Section 5.2.1, p. 5-2, 3rd paragraph	Given enough time, land use will be unrestricted/unpredictable, and USDOE institutional controls will disappear. Therefore, conservative scenarios (e.g., residential) may occur at some undefined future time. (DD)

Comment Number	Section, Page, Paragraph	Comment
267.	Section 5.2.1, p. 5-2, 4th paragraph	Regarding Table 5-1 footnote #1, RAGS (EPA, 1989) indicates that dermal absorption of airborne chemicals (nonrad and rad) is not an important route of uptake with the exception of airborne tritiated water vapor. Regarding Table 5-1, why is footnote #1 missing on dermal absorption under "Riparian Soil" and "Near Shore Sediment" scenarios? Re: Table 5-1 under "Seeps and River Water," why is sweat lodge ingestion included, since inhalation and dermal exposure are the CTUIR sweat lodge pathways? (DD)
268.	Section 5.2.2, p. 5-4, 2nd paragraph	Summing risks from remediated waste soil sites and unremediated groundwater confounds interpretation of total risk and seems inconsistent with the purpose stated here (i.e., "to evaluate the adequacy of soil remediation efforts at individual waste sites"). (DD)
269.	Section 5.3.1, p. 5-5, Number 3	Sculpin are used in calculations for the fish ingestion pathway, yet sculpin are not food fish. As noted in the report, their home range is near the shoreline where contaminants may be more concentrated, and use of sculpin data will likely grossly overestimate risk from the human fish ingestion pathway. Non-edible fish can be used to evaluate ecological risk, but it is not appropriate to use non-edible fish to evaluate human health risk. (SV)
270.	Section 5.3.2.1, p. 5-6 – 5-10 General	Please define the terms "broad area" and "local area" more thoroughly. This could be done in a glossary of terms, or these terms could be replaced by "reactor area" and "waste site area." (BR)
271.	Section 5.3.2, p. 5-7, 2nd paragraph	The complexity/uncertainty of the basement excavation model detracts from its utility. (DD)
272.	Section 5.3.2.1, p. 5-7, bullet 2	Ecology does not accept the assumptions used in the basement scenario. Ecology requires consideration of the concentration of the residual contamination in the soil consistent with WAC 173-340 (2001) Unrestricted Use. No assumptions about the size or orientation of the basement or excavation are applied for evaluating unrestricted use in WAC 173-340-740, -747 (2001). In reality, the dimensions of the residual contamination zone are completely unknown. The assumptions presented in this section are completely speculative (the ratio of contaminated soil to backfill, the volume of soil removed, the area over which soil is spread, etc.). It appears that the assumptions are not conservative (for instance, a 16 ft x 33 ft basement is small). Ecology made the following review comment for the Human Health Risk Calculations Handout (12/14/06): "The approach involves assuming a basement area, a slope for the bathtub ring, and a mixing ratio for excavated soil to backfill. This introduces significant uncertainty, as all of these assumptions are very debatable. Instead, the approach should involve assuming that the entire basement is dug into the bathtub ring. This is justifiable for both small and large waste sites, because the width, depth, and slope of the bathtub rings are not known. No backfill should be assumed to be mixed with the contaminated material. To obtain a measure of conservatism for this approach, a comparison should be made between the CVP concentrations and the 2001 WAC 173-340-740

Comment Number	Section, Page, Paragraph	Comment
		and -747 Standard Method B or Modified Method B (for Cr (VI)) values for protection of groundwater and direct contact pathways. This way the risk conclusions can be compared with conclusions that would be drawn from using the risk-based WAC 173-340 concentrations." This comment has not been addressed. Ecology requires evaluation of unrestricted use for non-radionuclides and uranium consistent with WAC 173-340-740 and-747 (2001). (BR)
273.	Section 5.3.2.1, p 5-7 thru 5-9, General	The basement excavation model is unnecessarily complicated. The complication arises from an attempt to model the mixture of contaminated and backfill soil, which is approximately a 1:1 mixture, and to address the uncertainties associated with backfill concentrations. It would be much simpler to just assume the excavated volume contains all contaminated "bathtub ring" soil, which might lead to a small overestimate (factor of 2) from this pathway. (SV)
274.	Section 5.3.2.1, p. 5-9, 1st paragraph	Note that extrapolating results from remediated waste sites to unremediated waste sites will introduce additional uncertainty into the interpretation. (DD)
275.	Section 5.3.2.1, p. 5-9, 3rd paragraph	The text states, "The second issue is how to represent the concentrations of constituents that were not analyzed in the CVP samples…Hanford site background data have been selected to represent the concentrations of metals and radionuclides that were not analyzed for in shallow- and deep-zone verification samples." It is not acceptable to assume background concentrations for contaminants that were not analyzed in the soils. This approach is not based on a technique that has widespread acceptance and does not err on behalf of protection of human health and the environment (see WAC 173-340-702(16)(b)(i) and (iv)). The CVPs are not a complete source of data so the gaps must be clearly indicated. State instead what was possible with the CVP data and stress the uncertainty that results from the missing data. (BR)
276.	Section 5.3.4, p. 5-11, last paragraph of page	The text discusses a comparison with background but does not tell the reader where to look to find the data and the comparison so that the reader can verify what is stated. Please include a citation of the table, figure, or text that covers the comparison. (BR)
277.	Section 5.3.4, p. 5-12, 2nd paragraph	"Figure 5-1" should be "Table 5-1." (DD)
278.	Section 5.3.5, p. 5-12, 3rd paragraph	A simpler model than PEF to calculate [EPC air] uses a constant for mass loading of particles in air (WDOH, 1997). For example: [EPC air] in mg/m3 air=(mg/kg soil)(1E-7 kg soil/m3 air). (DD)
279.	Section 5.3.6, p. 5-14, 7th paragraph	Note that because groundwater is largely unremediated, relatively high groundwater risks would be expected. (DD)
280.	Section 5.3.7, p. 5-15,	The use of groundwater concentrations as a substitute for river water concentrations is not appropriate, as this will grossly over estimate risk

Comment Number	Section, Page, Paragraph	Comment
	General	associated with river water pathways. There is plenty of river water data that can be used. In particular, substitution of groundwater for river water in the sweat lodge scenario will likely grossly overestimate risk from this pathway. The reason given for not using river water data is that these data are mostly from special studies (intended to find maximum concentrations) that likely do not reflect normal mixing conditions where groundwater entering the river is rapidly diluted. This implies that the concern is that these surface water data will over estimate normal river water concentrations. Yet, using groundwater as a substitute will even more so grossly over estimate river water concentrations. (SV)
281.	Section 5.3.6, p. 5-15, 1st paragraph	Correct reference from DOE/RL-96-91 to DOE/RL-96-61. (JAS)
282.	Section 5.3.8, p. 5-15, 1st paragraph of section	The text states, "VOCs were not among the detected organic chemicals, although other groundwater sampling has indicated the presence of VOCs at certain locations in the 100 Area and 300 Area. Therefore, while the protocol described in the following paragraphs is established for estimating VOC concentrations in indoor air, it has not been implemented in this risk assessment." The document goes on to describe the protocol that has not been used. Please clarify in the text the purpose of including the protocol, or considering eliminating it. (BR)
283.	Section 5.3.8, p. 5-15, 3rd paragraph	Why include the VOC indoor air protocol if it is not included in this risk assessment? The document is large enough already. (DD)
284.	Section 5.3.9, p. 5-17 – 5-18, General	Discuss any experimental data that support the equations used to calculate air concentrations for the sweat lodge pathway. Exposure point concentrations in most of the other media discussed in Section 5.3 are based on measured sample analysis or on measured transfer/uptake factors from the literature. The sweat lodge air concentrations appear unique in that they are not based on any measured data, and thus should be considered to have a high degree of uncertainty. Yet, uncertainty of the sweat lodge scenario is missing from the uncertainty analysis presented in section 5.7.9.2. Please include it. (SV)
285.	Section 5.3.9, p. 5-18, 2nd paragraph	In the EPC air equation, "ln (p*)" should simply be "p*," according to Equation 14 in Harris and Harper (2004). (DD)
286.	Section 5.3.1.2, p. 5-21, 4th paragraph	Re: Table 5-6, units for Ba are [mg/kg chicken or egg per mg/d] (not per mg/kg soil). (DD)
287.	Section 5.3.1.2, p. 5-22,	In addition to metals and rads, include organics too. EPA (2005) recommends that chicken feed (grain) is assumed to be grown at the

Comment Number	Section, Page, Paragraph	Comment
	1st paragraph	exposure site (not store bought). (DD)
288.	Section 5.3.1.2, p. 5-22, 2nd paragraph	"EPA (1995b)" should be "EPA (2005)." (DD)
289.	Section 5.3.1.3, p. 5-23, 2nd paragraph	Regarding the equation, please explain why "EPC pen" is a function of the "EPC broad" term, since "EPC broad" relates to free ranging cattle. (DD)
290.	Section 5.3.1.3, p. 5-24, 2nd paragraph	Re: the equation, why is "URs" not included for the EPC for penned cattle? (DD)
291.	Section 5.3.1.4, p. 5-24, General	As discussed in this section, a large amount of SESP data exist for game animals, and it appears more appropriate to use this data to calculate dose/risk from ingestion of game animals, so long as data from operational time periods is not used (for example only use data post 1990 or so). The arguments against using SESP data are not compelling. While it is true that the game data may not be specifically associated with known areas of residual contamination, the data can be classified into the "broad area" category, which is how the game ingestion pathway is defined anyway. Further, it doesn't matter if the data are associated with a waste area or not, it is simply what the concentrations actually are in the animals. In addition, this reviewer has extensively looked at historical SESP game data, and so long as data prior to about 1990 are not used (from the operational period), there is not much difference in concentrations pre vs. post remediation (in other words, over the last 15 years), as most of the radiological data are below detection limits. This section indicates that the SESP data are used to benchmark modeled tissue concentrations in the uncertainty analysis. However, the uncertainty analysis in section 5.7.9.2 only addresses Potassium-40 (for radionuclides), which is not even a Hanford contaminant. Include a discussion of how SESP game animal data compare to modeled game animal concentrations for Hanford specific contaminants. (SV)
292.	Section 5.3.1.5, p. 5-25, and Section 5.7.7, p. 5.87, General	This section is titled Food Fish. Yet sculpin are not a food fish, and sculpin should not be modeled as such and used in the human health risk assessment. There is plenty of bass, whitefish, salmon, steelhead, sturgeon data that should be used. (SV)
293.	Section 5.4.1, p. 5-26	The text states, "In general, an RME estimate of risk is at the high end of a risk distribution (90th to 99.9th percentiles), whereas the CTE estimate is associated with the mean or 50th percentile of a risk distribution…" Please include a statement telling the reader exactly what percentile was used for the RME, and whether the mean or median were used for the CTE

Comment Number	Section, Page, Paragraph	Comment
		in this risk assessment. (BR)
294.	Section 5.4.2, p. 5-28, 4th paragraph	Please clarify how RME risk, dose, and HI were calculated. For example, were relevant RME exposure factors in Table 5-8 typically incorporated into the scenario and pathway specific RME estimates, along with RME media EPC? (DD)
295.	Section 5.4.3, p. 5-31, 4th paragraph	Re: the CTUIR inhalation rate of 1.25 m3/h (30 m3/d), previous comments have criticized this value on a metabolic basis (e.g., Stifelman, 2003). (DD)
296.	Section 5.4.4, p. 5-32, 3rd paragraph	In addition to Table 5-11 (based on Exhibit 3-4 in EPA's dermal guidance, EPA/540/R/99/005), several other values for ABSd can be found at: http://www.epa.gov/oswer/riskassessment/ragse/index.htm. (DD)
297.	Section 5.4.5, p. 5-36, 1st paragraph	After a discussion with EPA (John Schaum), Equation A.17 (EPA/540/R/99/005) was found to contain an error. It should read: "(Dermal/Ingestion)>10% when Kp>1.9E-4 ABSGI (where ABSGI is expressed as a percent). An errata may be issued." (DD)
298.	Section 5.4.5, p. 5-36, 7th paragraph	RAGS (EPA, 1989) indicates that dermal absorption of airborne chemicals (nonrad and rad) is not an important route of uptake with the exception of airborne tritiated water vapor. The inhalation dose conversion factor (DCF) for H-3 includes an adjustment factor to account for dermal absorption. (DD)
299.	Section 5.4.7, p. 5-38, Gamma Shielding	At Hanford, dose/risk assessment typically use a value of between 0.7 and 0.8 for the gamma shielding factor. Use of a value in this range is recommended for consistency with other risk assessments. (SV)
300.	Section 5.5.1, p. 5-43, 7th paragraph	"Intensity of exposure" is more clearly described by "dose" here. (DD)
301.	Section 5.5.3, p. 5-45 to 5-46, General	Ecology supports the EPA comments by Marcia Bailey, D.Env., regarding mechanisms of carcinogenesis and use of default age-dependent adjustment factors (ADAFs) with carcinogens having a mutagenic mode of action. That is, with the exception of vinyl chloride, ADAFs should be applied to the other 11 mutagenic chemicals identified in Table 1b in EPA's 2005 Supplemental Guidance (EPA/630/R-03/003F). Vinyl chloride should be adjusted on a chemical-specific basis. Note too that benzo[a]pyrene should be adjusted before applying toxicity equivalent factors (TEFs) to other carcinogenic PAHs. Also, ADAFs need not be used with radionuclides, since FGR13 risk coefficients already include differential sensitivity across age (Keith Eckerman, ORNL, Email, 4/15/05). (DD)
302.	Section 5.5.4, p 5-46, General	This section mentions that risk factors can be applied as multipliers to calculated radiation dose equivalents. Usually, however, risk factors are applied as multipliers to the radiation metric "effective dose," not "dose equivalent." This should be corrected. (SV)
303.	Section 5.5.5, p 5-47, General	The text should reflect current radiation terms as defined by the ICRP. The term "effective dose equivalent" is obsolete. The correct term is "effective dose." The term "dose equivalent" is obsolete. The correct term is

Comment Number	Section, Page, Paragraph	Comment
		"equivalent dose." (SV)
304.	Section 5.5.5, p 5-47, General	Federal Guidance 13, used for estimating risk, is based on the latest ICRP dosimetric models; and dose coefficients associated with FG 13 (which can be obtained on a CD from the EPA web site) are in most cases identical to those tabulated in ICRP publication 72. Yet the dose coefficients in FG 11 and 12 are based on earlier and sometimes outdated ICRP models. Therefore, the EPA guidance referenced in the report is not consistent, in that it approves use of state-of-the-science models for risk estimates, but does not approve use of these models for dose estimates. This leads to risk estimates based on new models and dose estimates based on old models. Use of DCFs from ICRP 72 or those associated with FG 13 represent the most current scientific information on radiation dose, and should be used if the intent is to present dose estimates based on current scientific knowledge. (SV)
305.	Section 5.5.7, p. 5-48, 5th paragraph	Add CalEPA and ATSDR to Tier 3 (OSWER 9285.7-53), along with HEAST. (DD)
306.	Section 5.5.7, p. 5-49, 4th paragraph	Re: Figure 5-4, the third box down is unclear. Re: Figure 5-5, the second box down is unclear. Please explain. Using no value appears inappropriate before Tiers 2 and 3 have been investigated. (DD)
307.	Section 5.5.8, p. 5-50, 2nd paragraph	All three CDC reasons for not lowering the child blood lead level threshold are weak and refutable. (DD)
308.	Section 5.5.9, p. 5-51, 2nd paragraph	Because crystalline silica inhaled in the form of quartz is a known human carcinogen via an inhalation pathway, silica should not be excluded. (DD)
309.	Section 5.5.9, p. 5-52 to 5-53, General	There is probably no need to discuss chloride, hexadecanoic acid, octadecanoic acid, and orthophosphate, since these are common metabolites. (DD)
310.	Section 5.6.1, p. 5-54, 2nd paragraph of section	The text states, "The acceptability of any calculated excess cancer risk is generally evaluated relative to the target risk range of 10^{-6} to 10^{-4} described in the NCP." Please add a statement after this: However, Washington State regulations, WAC 173-340-708(5)(d) and (6)(d), require that cancer risks resulting from exposure to multiple hazardous substances and/or associated with exposure via multiple pathways not exceed a total excess cancer risk of 10^{-5}. (BR)
311.	Section 5.6.1, p. 5-54, 4th paragraph	Another chemical interaction is potentiation (e.g., effect of isopropanol on CCl_4 hepatotoxicity). (DD)
312.	Section 5.6.3, p. 5-56, 2nd paragraph	Please refer to Table 5-21 in this section. Note that FGR13 radionuclide cancer risk coefficients are central estimates, whereas nonradionuclide cancer slope factors are typically presented as 95% UCL. (DD)

Comment Number	Section, Page, Paragraph	Comment
313.	Section 5.6.4, p. 5-56, 4th paragraph	Note that OSWER 9200.4-18 regards the 15 mrem/y dose limit as corresponding to 3E-4 risk which is "essentially equivalent to the presumptively safe level of 1E-4." (DD)
314.	Section 5.6.4, p. 5-56, 5th paragraph	Please refer to Table 5-22 in this section. (DD)
315.	Sections 5.6.3 and 5.6.4, p 5-56 – 5-57, General	The text states: "The acceptability of any calculated excess cancer risk is evaluated relative to the target risk range of 1E-6 to 1E-4." Clarify how this target risk range relates to any promulgated state or federal law (not guidance) that is applicable to radioactive materials. The text states: "The acceptability of a calculated annual dose is evaluated … relative to a threshold dose limit of 15 mrem/yr". Clarify how this threshold dose limit relates to any promulgated state or federal law (not guidance) that is applicable to radioactive materials. Further, discus the fact that the threshold dose limit, and for that matter most radiation protection standards, corresponds to a risk that is greater than the target risk range. This leads to confusion as to which metric, risk or dose, will be used in decision making, as the target cleanup values for dose and risk are not consistent. Further, it appears that neither the target risk range nor the threshold dose limit are based on law when specifically applied to radionuclides, making it difficult to understand how the results of this report will be used for decision making. Please clarify. (SV)
316.	Section 5.7, p. 5-58, 5th paragraph	Re: Figure 5-6a, please provide more detail on the four high detected values for Aroclor 1254 in fish tissue from the BC Pilot project. (DD)
317.	Sections 5.7, p. 5-58, last paragraph of section	When discussing fish ingestion, include a discussion of the fact that most of the estimated fish ingestion radiation dose comes from non-detected Am-241, which from historical process knowledge is not a radionuclide expected to be found in the 100 or 300 Areas. (SV)
318.	Section 5.7.1, p. 5-59, 6th paragraph	Regarding Table 5-24, please see comment for p. ES-8, Table ES-1 (equivalent table). (DD)
319.	Section 5.7, p 5-59, last paragraph of section	Risk assessment results for the subset of naturally occurring radionuclides that are not associated with Hanford processes or operations should not be included in this report. These results do not contribute in any way to the stated purpose of this report, and they may potentially confuse a reader regarding the impacts of Hanford. (SV)
320.	Section 5.7.1, p. 5-59, last paragraph of page	The text states, "To a great extent, the range of the risk results shown in Table 5-24 are skewed by a relatively few remediated sites where RME risk calculations are inordinately affected by very high UCL values for certain

Comment Number	Section, Page, Paragraph	Comment
		sites." The reader needs to see the data associated with these high sites in a table in this chapter. Include the site IDs, operational area, and the concentrations of all "skewed" contaminants for each sample. The number of observations is important. If the high UCLs result from a small number of observations, state this. (BR)
321.	Section 5.7.1, p 5-59	The first paragraph in this section, going into p 5-60, is very confusing. Please clarify. (SV)
322.	Section 5.7.1, p. 5-60, 1st paragraph	Re: Figures 5-7, 5-10, 5-11, 5-16, and 5-19, clarify if cancer risk includes both rads and nonrads. Define "operational background" (e.g., Figure 5-7). How can this be considered background if the area was operational? The sentence which mentions "behavioral assumptions" implies that RME results are a function of RME exposure factors, in addition to the UCL for soil EPC. Please clarify. (DD)
323.	Section 5.7.1, p. 5-61, 1st paragraph	Does "operation area (no excavation)" correspond to "operational background?" (DD)
324.	Section 5.7.1, p. 5-61, 2nd to last paragraph	The text states, "The range of results shown for the Avid Angler exposure scenario pertains to the four exposure areas where COPC sediment concentrations were differentiated: the 100-B/C Area, the 100-N Area, the 300 Area and the entire 100 Area assessed in aggregate." This statement is unclear. Were the 100-B/C and N areas counted in with the entire "100 Area assessed in aggregate"? If not please indicate this in the text. (BR)
325.	Section 5.7.1, p. 5-62, 2nd paragraph	The text references monitoring wells and identifies them using "Well ID" (e.g. A4614) or "Well Name" (e.g. 199-N-80). It is recommended that the text consistently refer to all wells by their "Well Name" as this allows the reviewer to understand the location of the well. For example, the text refers to well A4614. It would be easier to understand the location of this well if the Well Name (199-H4-10) was given. (JAS)
326.	Section 5.7.1, p. 5-62, 1st paragraph	It is stated that high risk for fish ingestion is an artifact of high detection limits for organics (e.g., PAHs and PCBs) and widespread levels of organics in Columbia River fish. Why is the latter (i.e., widespread levels of organics in fish) an "artifact?" (DD)
327.	Section 5.7.1, p. 5-62, 2nd paragraph	It is surprising that cancer risk and radiation dose are "approximately equivalent" for soil vs. groundwater pathways, considering that soil has been largely remediated, while groundwater has not. (DD)
328.	Section 5.7.1, p. 5-62, 3rd paragraph	Note that the MTCA Method A cleanup level for lead for unrestricted soils is 250 mg/kg, based on blood lead levels. (DD)
329.	Section 5.7.1, p. 5-62, Risks Related to Lead; and Section 5.7.9,	The text states, "Because soil concentrations for lead are well below the most restrictive of EPA's soil screening criteria, no additional evaluation of lead is included..." The state's limit for lead in simple waste sites (sites with only a few contaminants) is 250 mg/kg (Method A). For sites with

Comment Number	Section, Page, Paragraph	Comment
	p. 5-97, top paragraph	more contaminants such as Hanford sites, the acceptable level of lead would be no greater than 250 mg/kg. Delete the statement quoted above and replace it with the following: "Because the concentration of lead at site 100-F-37 is close to the state's lead criteria of 250 mg/kg (WAC 173-340 (2001) Method A), the risks associated with lead and co-contaminants were evaluated. However, because other sites had lead concentrations below the state and EPA criteria, they were not evaluated further for lead." On p. 5-97, replace the EPA limit of 400 mg/kg for lead with 250 mg/kg based on state regulations. (BR)
330.	Section 5.7.1, p. 5-63, 3rd paragraph	The last sentence describing the variability in RME results in Figure 5-7 is unclear. Please clarify. This sentence is repeated for each scenario. (DD)
331.	Section 5.7.2, p. 5-63, 4th paragraph	The text states, "Because the higher "broad area" risk values are related to beef and milk ingestion, this finding is likely due to the modeling of direct soil ingestion by grazing cattle in the "broad area" risk calculations but not for penned cattle in the "local area" calculations." It is not clear why "local area" cattle are not allowed to ingest soil while grazing over the 2 ha on which they are penned, which should be the waste site itself. This seems arbitrary. Please re-evaluate allowing the cattle to ingest waste site soil. (BR)
332.	Section 5.7.2, p. 5-63, 5th paragraph.	Add a definition for "operational area baseline value." Is this the same as operational background on Figure 5-8? Also, please rephrase the statement "As site risks approach the operational area baseline, the majority of the calculated risk is a function of the same baseline conditions in surface soils." What is meant by "same baseline conditions in surface soils"? (BR)
333.	Section 5.7.2, p. 5-63 – 5-86, General	The percentage of risk, dose, and hazard from particular contaminants for each of the listed sites does not add to 100% in many cases. Include the chemicals that account for 95% or greater of the contamination. Also, include for each of the listed sites the total risk at the site in terms of ILCR, HI, or dose. (BR)
334.	Section 5.7.2, p. 5-64, 4th paragraph	It is not conventional to define ILCR as incremental, relative to reference site risk. The convention is incremental, relative to demographic background population risk (e.g. see p. 5-54 for United States background cancer risks). (DD)
335.	Section 5.7.2, p. 5-65 – 5-66, and Section 5.7, General	The text lists sites with the highest RME dose values. Specifically, these are the sites with dose values greater than the threshold dose limit. In many cases, the high doses are an artifact of the methodology to determine the representative contaminant concentrations. For example, site 316-5 has an RME radiation dose value of 370 mrem/yr, with the majority of that dose coming from Cs-137 via external radiation and

Comment Number	Section, Page, Paragraph	Comment
		from U-238 via food ingestion. The calculation of dose from each of these pathways is based on concentrations of Cs-137 and U-238 in soil. Examination of the data for site 316-5 indicates that the Cs-137 concentrations in soil ranged from 0.007 to 2.9 pCi/g, yet the 95% UCL concentration (which is used to determine the RME concentration) is 126 pCi/g. The U-238 concentrations in soil ranged from 0.71 to 119 pCi/g, yet the 95% UCL concentration is 533 pCi/g. In each case, the concentrations used to determine radiation dose and risk are absurd, as they are purely an artifact of the method used to determine the 95% UCL value, and they grossly aggagerate the condition of the remediated site. The problem must be fixed so that the report gives an accurate description of the cleanup progress. All site/scenario combinations with dose values greater than the threshold dose limit should be examined, and care should be taken that CTE and RME concentrations are based on sound, scientifically defensible methods. This comment applies to all site and scenario combinations. (SV)
336.	Section 5.7.3, p. 5-69, 5th paragraph	Re: risks>1E-02, please see second part of comment for p. ES-8, Table ES-1. (DD)
337.	Section 5.7.3, p. 5-70, 5th paragraph	Define "Recreational Area." (DD)
338.	Section 5.7.3, p. 5-71, General	Again (see similar comments elsewhere), the high radiation doses for some of the sites are an artifact of the method for calculating representative contaminant concentrations, and they do not provide an accurate assessment of these sites. In some cases, the problem is due to an exaggerated 95% UCL concentration that is many times greater than the maximum measured concentration (Cs-137 in soil at 316-5, for example), and in other cases it is due to substituting a detection limit from an unacceptable method for the contaminant when the contaminant was not detected (Am-241 in soil, with no detected results, substituting a high gamma spectroscopy detection limit for the concentration when alpha spectroscopy should be used for this radionuclide, for example). Regardless of the cause, these dose calculations need to be redone with contaminant concentrations that are based on sound, scientifically defensible methods. (SV)
339.	Section 5.7.7, p. 5-87,	The text states that the fish results are affected by a systematic problem with elevated detection limits for organic chemicals in fish tissue. Please

Comment Number	Section, Page, Paragraph	Comment
	General	recognize in the text that the same problem exists for the radionuclide Am-241. (SV)
340.	Section 5.7.7, p. 5-87, 4th paragraph	Regarding As in fish tissue, although inorganic As may be more toxic than organic As, methylated trivalent As species are also toxic, including monomethylarsonous acid (MMA^{III}), and dimethylarsinous acid (DMA^{III}) (Nesnow et al, 2002; Hughs, 2002). Importantly, the FDA (1993) citation has a note on its website, indicating this guidance is no longer current science (http://www.cfsan.fda.gov/%7Efrf/guid-as.html). Because of the available toxicity factors for inorganic As and the lack of toxicity factors for organic trivalent As species, inorganic As should be measured in sculpin (using EPA Method 1632A) for calculating risk for the fish ingestion pathway. Total arsenic should also be measured in sculpin (EPA Method 6010/6020), so that percent inorganic As can be calculated. Due to the uncertainty in laboratory analysis of inorganic As, use of sculpin as a surrogate species for Columbia River food fish (e.g., variation in toxicokinetics, behavior), and small sample size (uncertain respresentativeness), risk should also be estimated by assuming a bounding percent inorganic As in fish tissue (e.g., 30%), based on a literature review. Note that this latter method also suffers from use of a surrogate species, since total As is measured in the surrogate. Hopefully, both of these methods will inform risks associated with the fish ingestion pathway (DD, BR)."
341.	Section 5.7.7, p. 5-88, 2nd paragraph	Re: risks>1E-02, please see second part of comment for p. ES-8, Table ES-1. (DD)
342.	Section 5.7.7, p. 5-88, 4th paragraph	Re: As in fish tissue, although inorganic As may be more toxic than organic As, methylated trivalent As species are also toxic, including monomethylarsonous acid (MMA^{III}), and dimethylarsinous acid (DMA^{III}) (Nesnow et al, 2002; Hughs, 2002). Importantly, the FDA (1993) citation has a note on its website, indicating this guidance is no longer current science (http://www.cfsan.fda.gov/%7Efrf/guid-as.html). (DD)
343.	Section 5.7.7, p. 5-88, and Figures 5-28 – 5-33, p. 5-147 – 5-149	The text states, "The background RME and CTE cancer risk values for fish ingestion…were about a factor of 100 lower than those in the 100 Area and 300 Area. This is because the problem of elevated PAH detection limits was not present in the reference area fish tissue results." The text does not explain why this is the case. Provide an explanation in the text. Also, the fish ingestion figures should include a footnote for 100-NR-2 referring the reader to p. 5-88 for an explanation about the apparently lower risks at 100-NR-2. At a glance the figures suggest that there is less risk at 100-NR-2, while there was simply a different set of contaminants evaluated. (BR)
344.	Section 5.7.7, p. 5-89, General	Consumption of fish from the Columbia River is arguably the single most scrutinized Hanford related exposure pathway by the public. As such, it is inherent that this document present an accurate assessment of contamination

Comment Number	Section, Page, Paragraph	Comment
		in fish. The reported radiation doses, and the corresponding contributions to risk, for the fish ingestion pathway are seriously flawed, and these calculations must be redone before a final version of this report is submitted. The problem stems from the exposure point concentration for Am-241. The Am-241 data come from 24 sculpin fish samples. The problems are as follows: 1) Sculpin are not a fish that people eat. 2) The whole organism was analyzed. It is more typical to analyze just the meat for a human consumption pathway. 3) There is no historical process knowledge indicating that Am-241 should be present in 100/300 Area groundwater, seep water, river water, or fish. 4) There are no reported concentrations for Am-241. Instead, the MDA is substituted for the concentration. This is not standard for radiochemical analysis. It is standard to report a concentration, regardless of whether it is above or below a sample calculated MDA. 5) All 24 Am-241 results are considered not detected, and there is a fundamental problem if large radiation doses are reported for an undetected analyte. 6) The method used to detect Am-241 is gamma spectroscopy. The proper method to detect Am-241 is alpha spectroscopy. The detection limit for Am-241 using gamma spec is about 100 times higher than that for alpha spec. Therefore, the MDA values that were substituted for the sample concentration are unrealistically high. In fact, they correspond to doses greater than the threshold dose limit. There is a fundamental problem if detection limits are higher than regulatory criteria. 7) Am-241 is the largest contributor to background radiation dose, yet Am-241 can only be made in a reactor and it is impossible for it to be a background contaminant. Either eliminate Am-241 from the analysis, reanalyze the sculpin meat for Am-241 using alpha spectroscopy with a suitable detection limit, or resample and analyze for Am-241 using alpha spec. This comment also applies to Am-241 in soil, as the same problem occurs in which non detected results lead to large radiation doses, in particular for the CTUIR scenario. (SV)
345.	Section 5.7.7, p. 5-89, 2nd paragraph	Re: Am-241, because this COPC was apparently nondetected with a high (poor) detection limit, use of half detect resulted in a relatively high risk. Appropriately sensitive detection limits are needed when using half detect to estimate risks. More importantly, statistical analysis with radionuclide data should employ actual values reported (including negative values), rather than half detect. (DD)
346.	Section 5.7.7, p. 5-89, 5th paragraph	Re: PCBs, because this COPC was apparently nondetected with a high (poor) detection limit, use of half detect resulted in a relatively high risk. Appropriately sensitive detection limits are needed when using half detect to

Comment Number	Section, Page, Paragraph	Comment
		estimate risks. (DD)
347.	Section 5.7.8, p 5-90 – 5-91, General	The presence of risk assessment for these naturally occurring radionuclides is questionable. The results do not seem to contribute to the purpose of the report, and their inclusion only seems to cloud the message of the report. (SV)
348.	Section 5.7.7, p. 5-90, 1st paragraph	The text states, "But only about 50% of the RME HI and 50% of the CTUIR HI, is related to PCBs. The remaining contribution is from 3, 4-methylphenol. The importance of 3, 4-methylphenol only in the UCL calculations is again an indication of instability in this calculation." Include in this discussion the number of 3, 4-methylphenol analyses, the number of non-detects, and the values that were substituted for non-detects. If there were many analyses the UCL calculation should not be unstable. Clarify this for the reader. (BR)
349.	Section 5.7.8, p. 5-91, 4th paragraph	Regarding Figure 5-42, figure title should specify dose (not cancer risk). (DD)
350.	Section 5.7.9, p. 5-91, 5th paragraph	Please note explicitly that a probabilistic risk assessment (PRA) was not performed and that PRA can be useful in assessing uncertainty. In addition, uncertainty should be distinguished from variability. (DD)
351.	Section 5.7.9, p. 5-92	Under Data Collection and Evaluation, there is uncertainty, in the form of overestimate, from statistical methods that lead to UCL concentrations that are significantly higher than maximum detected concentrations. (SV)
352.	Section 5.7.9, p. 5-92, bottom of page	The text indicates that uranium was only evaluated as a radionuclide and not as a toxic metal. It also indicates that this would result in an underestimation of risk. Please include uranium in hazard index calculations. This is an unaccounted for source of chemical hazard and the state requires that it be included as a toxic metal (see the MCL and other characteristics given in the CLARC database, and IRIS for the reference dose for uranium soluble salts). It is evaluated as a hazardous metal in other Hanford risk assessments and should not be overlooked here. (BR)
353.	Section 5.7.9, p. 5-92, bottom of page	The document states that "Estimation of UCL values when biased verification sampling results in one or more outlier values" results in an overestimation of risk. This is misleading. No definition of "outlier" or source of outlier results are provided. Results that appear to be outliers can occur in both directions. Use of biased sampling can miss high concentration areas that are unknown prior to sampling. The use of biased sampling leads to errors, the direction of which are unknown. Change the potential bias to "Unknown." (BR)
354.	Section 5.7.9, p. 5-92 to 5-93	Regarding data collection and evaluation, additional sources of uncertainty include selection of COPCs, non-detected COPCs, statistical issues associated with small sample size and non-random (judgmental) sampling, and combining data of variable quality. Regarding exposure assessment, additional sources of uncertainty include parameters and models in environmental modeling (e.g., trophic transfer factors, partition coefficients,

Comment Number	Section, Page, Paragraph	Comment
		BCFs), overly complex exposure models (e.g., basement excavation), a fragmented approach to spatially assessing risk (waste site by waste site), minimal evaluation of temporal variation (primarily a cross sectional study design), bioavailability, and problems with reference site selection (e.g., use of borrow pits). Regarding toxicity assessment, additional sources of uncertainty include uncertainty in dose conversion factors (DCFs), uncertainty in toxicity factors (e.g., IRIS CSF/RfD, FGR13 risk coefficients), route to route extrapolation of toxicity factors, use of surrogate toxicity factors, toxicokinetics, COPC interactions (besides additivity), and no adjustment of mutagenic nonrad carcinogens (e.g., benzo[a]pyrene) with age-dependent adjustment factors (ADAFs) for children. Re: risk characterization, sources of uncertainty include summing cancer risks for rads and nonrads, additivity of hazard quotients, integrating groundwater pathway contributions to risk, and teasing out background contributions from Hanford site risk. (DD)
355.	Section 5.7.9, p 5-93, Exposure Assessment	Under Exposure Assessment, the text mentions K-40 in beef and milk. Please clarify if K-40 is included in the beef/milk ingestion pathway for the incremental radiation dose results. If it is, it should be taken out. This radionuclide should not be included in the risk assessment, as it is purely from background and not Hanford related. Natural variations between K-40 concentrations at reference and operational sites may lead to erroneous results upon subtracting the reference K-40 contribution from the operational contribution. (SV)
356.	Section 5.7.9, p 5-93, Toxicity Assessment	Under Toxicity Assessment, the text mentions the underestimate from application of DCFs to children. This is because the DCFs employed come from FGR 11 and FGR 12 which are for adults. However, age dependent DCFs exist in ICRP 72, and these DCFs are based on more current dosimetric models. This report should consider using state-of-the-science DCFs. (SV)
357.	Section 5.7.9, p 5-93, Toxicity Assessment	Under Toxicity Assessment, there is uncertainty as to whether there is actually any risk at all from the low radiation doses reported in this report. Cancer risk has not been unambiguously measured for such low doses. (SV)
358.	Section 5.7.9.1, p. 5-94, 2nd paragraph	Regarding U, the information presented on p. 5-92 indicates that U was not assessed for nonrad effects, while text here claims otherwise. Please clarify. (DD)
359.	Section 5.7.9.1, p. 5-94, 3rd paragraph	The 10th line states "have not been not evaluated." So they have been evaluated? If the verification data was not reviewed for quality criteria then was it weighted differently than the collected data? The site verification data has contractor specific SAPs associated with it which could be referenced for analytical performance requirements. (JY)
360.	Section 5.7.9.1, p. 5-95,	When COPCs are all non-detect, these should only be retained if site/process knowledge supports their presence or if inappropriately high (i.e., poor)

Comment Number	Section, Page, Paragraph	Comment
	4th paragraph	detection limits were employed (e.g., PCBs). In the case of COPCs analyzed with elevated detection limits, these samples should be re-analyzed with appropriate detection limits. (DD)
361.	Section 5.7.9.1, p. 5-96, 1st paragraph	The high values reported for the Aroclors 1254,1260 should be easy to trace back to dilution problems, QC, etc. with the analytical testing. "It seems likely" is too subjective and not based on fact. The data should be researched back for any analytical or sampling errors. (JY)
362.	Section 5.7.9.1, p. 5-96, 2nd paragraph	Waste soil verification data is usually collected from samples taken after the site has been remediated. This should be a statistically random sample exercise with little bias. Are you using pre and post closure verification data? These would be two separate data sets. Pre would be more indicative of an actual baseline data set where post would be a remediation set. Why would the UCL's be deemed unstable? (JY)
363.	Section 5.7.9.1, p. 5-97, 1st paragraph	This Aroclor-1254 result (9.4 ppm at waste site 600-132) supports the presence of PCBs. (DD)
364.	Section 5.7.9.1, p. 5-97, 3rd paragraph	Re: nitric acid representing the GI tract, COPC uptake can be complicated by other toxicokinetic factors (e.g., first pass liver effect). (DD)
365.	Section 5.7.9.1, p. 5-97, 3rd paragraph	It is not universally accepted that PAHs and PCBs "are not key Hanford contaminants." (DD)
366.	Section 5.7.9.1, p. 5-100, paragraph after bullets	The statement "As described in Section 5.3.2, the basement excavation model was developed to maximize potential exposures to contaminants in the shallow zone via excavation…" is misleading. An assumption of excavation for a basement is the premise of calculations for cleanup levels for unrestricted land use in WAC 173-340. The evaluation done here results in a dilution of contaminated residual soil by backfill, which is non-conservative. Exposure is not maximized by this evaluation. Additional misleading text follows the quoted statement. Please delete this paragraph and change the evaluation to one in which only residual contaminated soil is excavated for the basement, rather than mixed with backfill. As mentioned in a previous comment, the width and depth of the residual contaminated zone are unknown and should not be assumed to have the speculative, limited configuration used in this evaluation. (BR)
367.	Section 5.7.9.3, p. 5-104, 2nd paragraph	Regarding carcinogenic PAHs and ADAFs, see comment for p. 5-45 to 5-46, Section 5.5.3. (DD)
368.	Section 5.7.9.3, p. 5-104, 4th paragraph	Regarding As in fish tissue, see comment for p. 5-88, para 4. (DD)
369.	Section 5.8, p 5-105, General	Risk Assessment for groundwater exposure seems inconsistent with the stated purpose of this report. According to the Executive Summary, the purpose appears to be to characterize current risks that may be posed by

Comment Number	Section, Page, Paragraph	Comment
		residual, post remediation contaminants, by evaluating sites after cleanup has been completed. Groundwater has not been remediated, so reporting risk from groundwater is not consistent with the purpose. (SV)
370.	Section 5.8, p. 5-105, 2nd paragraph of section	The calculation of background risks for groundwater does not appear to use standard methods. Cite references that support the methods used and justify any deviations from standard methods. (BR)
371.	Section 5.8, 5-105, 2nd paragraph	The text states, "...representative monitoring wells were selected by evaluating analytical data...and by selecting monitoring wells that spatially represent each operational area." It is not clearly defined in this document or in the SAP what is considered to be "representative." To provide validity to the risk assessment results, this must be clearly defined in the text. Later in the paragraph, the text issues a disclaimer stating that groundwater results are semi-quantitative because only a small subset of groundwater data was used. If monitoring wells were selected to be truly representative of existing contamination, this disclaimer would not be necessary. However, it is not clear how these wells were selected. (JAS)
372.	Section 5.8, 5-105, 3rd paragraph	Correct reference from DOE/RL-96-91 to DOE/RL-96-61. (JAS)
373.	Section 5.8, General	A few contaminants contribute to risk that are not commonly part of the groundwater monitoring program (e.g. aroclor-1254, hexachlor epoxide) and are somewhat unexpected in groundwater. Were there efforts to confirm these data (i.e. was resampling performed and were contaminants like these detected in more than one sample from the affected wells?)? Please address in the text. (JAS)
374.	Section 5.8.1, General	This section repeatedly refers to one well showing risk results of zero for cancer and radiation dose. The text should identify the well by name, provide an explanation for these results, and explain what this means in terms of risk. (JAS)
375.	Section 5.8.1, p. 5-106, 2nd paragraph	Sweat lodge water ingestion is specified in this paragraph. However, Harris and Harper (2004) include only inhalation and dermal absorption in their sweat lodge scenario. Please clarify. (DD)
376.	Section 5.8.1, p 5-106 - 5-107	It was stated earlier in the text that groundwater was being used to evaluate the sweat lodge scenario because of supposed problems with using river water. This protocol will certainly overestimate radiation dose from this pathway. River water concentrations should be used. (SV)
377.	Section 5.8.2, 5-109, 1st paragraph	A4669 is listed as a well with a risk contribution from heptachlor epoxide. This well is not listed in the tables in this section (Table 5-66 to 5-83) and it is not evident from data in the RCBRA Database that any organic or pesticide analyses were performed for samples from this well. (JAS)
378.	Section 5.8.2, 5-109, 2nd paragraph	The text states that there is uncertainty regarding the analytical results for arsenic and radium because their ranges in sample results are well above Hanford Site background. It is not clear from the text why this presents

Comment Number	Section, Page, Paragraph	Comment
		uncertainty. Does the uncertainty lie with the background values or with the sample data? Please clarify in the text and present evidence for the conclusion. (JAS)
379.	Section 5.9, p. 5-115, 5th paragraph	Section 5.9 on river effluent pipelines appears as a disjointed "add on" that is difficult to interpret, in relation to the assessment as a whole. (DD)
380.	Section 5.10 p. 5-116, 4th and 5th paragraphs	The human health risk assessment could be simplified by evaluating only high and low bounding exposure scenarios (i.e., CTUIR and Industrial/Commercial, respectively) for "local areas" and one recreational scenario for "broad areas" (e.g., Avid Angler), rather than the seven evaluated. This would avoid a lot of redundancy/overlap, without sacrificing key information. (DD)
381.	Section 5.10 p. 5-117, 2nd paragraph	Elevated detection limits (e.g., PAHs and PCBs in fish tissue) require re-analysis with appropriate detection limits. (DD)
382.	Section 5.10, p. 5-117, 3rd paragraph	Specify "threshold criteria." (DD)
383.	Section 5.10, p 5-117, last paragraph and bullets	As stated in previous comments, many of the high radiation doses, and corresponding risks, listed in the conclusion are a result of inappropriate statistical values used for representative contaminant concentrations. This problem needs to be resolved before the report is finalized. (SV)
384.	Section 5.10, p. 5-118, Uncertainty 1	The text states, "The use of a basement excavation model for accessing subsurface contamination that assumes worst-case location and orientation of a basement relative to the historical footprint of the waste site" is misleading. The worst case would be a basement dug along the contaminated edge of a waste site, having a width and depth entirely within the contaminated zone. As previously mentioned in prior comments, the width and depth of the contaminated zone are completely unknown. The analysis here involved dilution with backfill, which is not worst case. Re-evaluate using a basement dug entirely into the residual waste, and adjust this statement accordingly. (BR)
385.	Section 5.10, p. 5-118, Uncertainty 2	The text states, "The use of screening-level models with protective assumptions to model transport of chemical and radionuclides among different environmental media for the purpose of calculating exposure point concentrations" is misleading. The model used for chemicals was RESRAD (CVPs/RSVPs), which has not been demonstrated to be compliant with the current WAC 173-340-747(8) requirements for alternative fate and transport models. The state's default model is the 3-phase model (WAC 173-340-747 equation 747-1). This is a more conservative model than RESRAD. The modeling for the vadose zone to groundwater pathway was not conservative. Compliance with current regulations is expected for the final ROD. Please delete #2. (BR)
386.	Figure 5-4,	The third box in the flowchart requires an explanation (in the text). What

Comment Number	Section, Page, Paragraph	Comment
	p. 5-122	does this mean? Also, when the answer is yes for this box, what does "Use No Value for this Route and Endpoint" mean? The third box seems unnecessary. Also, add a footnote citing how OSWER 9285.7-53 was used for developing this figure. (BR)
387.	Figures 5-7 – 5-21, p. 5-127 – 5-141	Provide an explanation in the text for the calculation of the operational background values. On p. 5-63, 3rd paragraph, the text states, "The variability shown in RME results (i.e. the spread of calculated values above a theoretical line along the lowest calculated RME values) is a function of the protocols used in calculating the UCL exposure point concentrations in soil." It is possible that this was intended as the explanation. However, this text is very unclear. The background lines appear to represent an average for the waste sites. Please rephrase the quoted text and provide a clear explanation for the "operational background." (BR)
388.	Table 5-1, p. 5-165,	It appears that the Sweat Lodge Ingestion pathway listed under CTUIR is a mistake - i.e. the pathway does not really exist. (SV)
389.	Table 5-3, p. 5-167	Please add a column for the source of each Henry's constant. Ecology generally uses the Henry's constants in the CLARC database. Many of these values are different than the values in CLARC. Please assure that the values are at least as conservative as the CLARC values. (BR)
390.	Table 5-5, p. 5-173	Please add a column for the source of each octanol-water coefficient. Ecology generally uses the octanol-water partition coefficients in the CLARC database. Please assure that the values are at least as conservative as the CLARC values. (BR)
391.	Table 5-26a – 5-45b, p. 5-242 – 5-283	Some risk values are given as zero. Please use some other symbol and an explanatory footnote in lieu of reporting zero. (BR)
392.	Table 5-83, p. 5-310	The ratio of background HI/Total HI is provided. However, a ratio of Total HI/background HI would be more informative because higher ratios would correspond to a relatively greater hazard at a site. As presented the reader must be aware that lower values correspond to relatively greater site contributions of hazardous chemicals. Please consider presenting the inverse of the values on this table. (BR)
393.	Chapter 6, General	Use of the gradient approach is not clearly or easily understood. Clarify in the text how the gradient analysis results and the reference site comparisons are linked. (JV)
394.	Chapter 6, General	EPA guidance (EPA 540-R-97-006) says it may not be practical to evaluate populations - because of the "noise of the system." Explain in the text how the uncertainty associated with population abundance was resolved. (JV)
395.	Chapter 6, General	Include in the summary statements a discussion about lost lines of evidence. (JV)
396.	Chapter 6, General	Data tables & figures should be located in body of text and not in appendices. (JV)
397.	Section 6.2., p.6-1,	The text states, "The specific purpose of this ERA is to characterize potentially adverse effects on plants and animals that may be posed by

Comment Number	Section, Page, Paragraph	Comment
	1st paragraph of section	residual, post-remediation contaminants at the Hanford site." Given this, this ERA is not a baseline risk assessment. Rather it is something in between baseline and verification sampling. Explain in the text how this ERA accounts for future risk impacts which may or may not be the result of contaminants. (JV)
398.	Section 6.2.1, p. 6-2, 1st paragraph	Rewrite text to be more consistent with guidance: "Relative to plant-eating wildlife (or to wildlife that eat a variety of foodstuffs), therefore, receptors feeding *solely or primarily* on invertebrates should experience relatively greater exposure to radionuclides and metals and are a focal group for assessment of ecological risk." (JV)
399.	Section 6.2.1, p. 6-2, 2nd paragraph	Rewrite text to be consistent with guidance: *EPA defines assessment endpoints as explicit expressions of the actual environmental values (e.g., ecological resources) that are to be protected (USEPA, 1992a). Useful assessment endpoints define both the ecological entity (e.g., .species, ecological resources, habitat type, etc) and attribute(s) (e.g., reproductive success, aerial extent) at the site of the entity.* Remainder of paragraph is okay. (JV)
400.	Section 6.2.1, p. 6-3, 2nd paragraph	Note that use of a surrogate receptor (e.g., sculpin) for salmon introduces a source of uncertainty in risk estimates, involving salmon attributes, as an assessment endpoint. (DD)
401.	Section 6.2.1, p. 6-3, paragraph after bullets	Include clarifying text addressing the following questions: (1) What information supports choosing an invertebrate-eating duck to represent a herbivorous duck? (2) What correlation is there between what contaminants might be taken up by an aquatic plant to an insect? (3) Are organics taken up by plants to a lesser or greater extent than by insects? (4) Are metals more readily taken up by insects than aquatic plants? (JV)
402.	Section 6.2.1, p. 6-3, paragraph after bullets	The most sensitive species of receptors common to the remediated and reference sites should be used as test organisms. Discuss in the text how sculpin at any age would represent salmon fry. Discuss whether or not fry are more susceptible to effects of contaminants than sculpin at any age? (JV)
403.	Section 6.2.2, p. 6-4, 2nd paragraph	A statement made about the inclusion of vegetated areas around the perimeter of remediated site. Provide in the text the rationale for not using the fringe areas for comparison against the reference sites. Using the fringe areas would be more representative for a baseline risk assessment. (JV)
404.	Section 6.2.2, p.6-4, last paragraph	Explanation of use of the gradient analysis approach is unclear. Are the same receptors being compared from sites to the same reference site? Clarify text. Insert 'contaminant' in front of the words gradient analysis for clarity. (JV)
405.	Section 6.2.2, p. 6-4, 5th paragraph	Please explain how gradient analysis is performed. For example, is the reference site necessarily included? (DD)
406.	Section 6.2.2,	Explain in the text (1) How the uncertainty caused by skewed gender ratios

Comment Number	Section, Page, Paragraph	Comment
	p. 6-8, 2nd to last paragraph	was resolved. (2) How this factor influenced data interpretations for reproduction. The first would appear to affect the second. (3) Would the interpretations for the latter need some type of qualifications? (JV)
407.	Section 6.2.2, p. 6-9, Hypothesis 1, Null	Hypothesis 1 in this document is not consistent with that in the DQO document (BHI-01757 pg. 5-17). Change this hypothesis to that used in the DQO document. The DQO document mentions evaluating the combined effects of COPEC where appropriate. (JV)
408.	Section 6.3, p. 6-13 – 6-24, General	Clarify in the text if contaminant concentrations were measured in the environmental media at the same locations at which the organisms were collected and at the same time [spatially and temporally]. (JV)
409.	Section 6.3.1, p. 6-13, General	It appears that the text is discussing measurement, rather than assessment, endpoints. According to EPA 540-R-97-006, a measurement endpoint is a measurable biological response to a stressor that can be related to the valued attribute chosen as the assessment endpoint. Please provide the link between measurement and assessment endpoint, explain how these two might be different, but that a measurement endpoint can be used to make inferences about risks to the assessment end point. (JV)
410.	Section 6.3.1.1, p. 6-13, 1st paragraph of section	Replace *obviated* with *prevented.* Also indicate in the text that the result was elimination of one hypothesis (Hypothesis 4 for terrestrial invertebrates) as well as loss of data. (JV)
411.	Section 6.3.1.1, p. 6-14, 3rd paragraph	Include months for reference site data collection for plants (*approximately* needs definition). Also, clarify how the array was placed. (JV)
412.	Section 6.3.1.1, p. 6-14, Mammals	Provide a figure showing the trap placement and grids. It is difficult to visualize based on the text. (JV)
413.	Section 6.3.1.1, p. 6-14, General	Clarify how placement of array in the center of the investigation area actually captures the requirement to address the "fringe areas." Sampling in the "fringe areas" is intended to address possible contaminants left in place. Therefore, capturing should take place there too. (JV)
414.	Section 6.3.1.1, p. 6-15, 1st paragraph	Clarify in the text the meaning of "limited to one habitat type when possible?" (JV)
415.	Section 6.3.1.1, p. 6-15, 1st paragraph	Include a table with the species and numbers of organisms per species collected at each site. Also, discuss in the text the uncertainties associated with collecting different species (example: different mice species) at different sites. (JV)
416.	Section 6.3.1.1, p. 6-15, 1st paragraph	Identify how many trap days were used at each site. EPA guidance [EPA540-R-97-006] says more than 3 days puts results at risk of being non-representative as it allows mammals once peripheral to the trapping area to migrate into the area. Explain in the text how exceeding 3 trap days confounds statistical analyses and potential acceptance of the alternate hypothesis. (JV)

Comment Number	Section, Page, Paragraph	Comment
417.	Section 6.3.1.2, p. 6-16, last paragraph of section	For aquatic community measure, include text and sections similar to terrestrial sections (i.e., Aquatic Plants & Mammals, etc) (JV)
418.	Section 6.3.1.2, p. 6-16, 2nd paragraph	Hand picked crayfish introduce bias into macroinvertebrate tissue analysis and should be noted in the uncertainty assessment. (DD)
419.	Section 6.3.2, p. 6-16, 1st paragraph	Intent is unclear. Was risk to terrestrial plants & soil biota also evaluated & calculated?
420.	Section 6.3.2, p. 6-16, 3rd paragraph	For aquatic environs, lower & middle trophic levels were represented by concentrations in water or sediment. Provide text explaining why tissues were not also measured for COPCs.
421.	Section 6.3.2, p. 6-16, 4th paragraph	It is somewhat inconvenient to have the eco CSM located back in Section 2.0. (DD)
422.	Section 6.3.2 p. 6-16, 6th paragraph and Section 6.3.2.1, p. 6-16 – 6-17	It is not clear to what extent COPC tissue concentrations were measured or modeled. Please clarify. In addition, were modeled COPC concentrations in higher trophic levels ever validated against corresponding measured concentrations? (DD)
423.	Section 6.3.2.1, p. 6-17, 1st paragraph	Are paired biotic/abiotic samples (used to estimate empirical transfer factors) paired in space and time? (DD)
424.	Section 6.3.2.2, p. 6-18, 3rd paragraph	Since reptiles and amphibians were not evaluated (except for the FETAX bioassay), this should constitute an uncertainty in the assessment, especially since these taxonomic groups are generally sensitive to contaminants (e.g., Stuart et al, 2004). (DD)
425.	Section 6.3.2.2, p. 6-19, 4th paragraph	Re: Tables 6-1a, 6-1b, and 6-1c, please define variables. Re: Table 6-1c, "Water BCG" and "Sediment BCG" might be replaced with "Aquatic Biota BCG" and "Sediment Biota BCG," respectively to better denote receptors. (DD)
426.	Section 6.3.3, p 6-21, General	The text states that concentrations in abiotic media (soil, sediment, water) are compared directly to BCGs (for radionuclides). Please specify exactly what concentrations are used in this comparison. For example, is it the RME or CTE concentrations used in the human health portion of the risk assessment, or something altogether different? There should be consistency between the human health and ecological portions of the risk assessment as to what abiotic media concentrations are used for assessments. But it is not clear that this is the case. For example, it appears that none of the sum of fraction soil analyses were greater than unity, which means that none of the analyte specific concentrations were

Comment Number	Section, Page, Paragraph	Comment
		greater than the BCG. However, in the human health analysis, there were concentrations of Cs-137 at some sights in excess of 100 pCi/g (note that this high concentration has its own problems which were pointed out in other comments), and this value is over the BCG of 21 pCi/g. Therefore, it seems that the RME values from the human health chapter were not used in the eco assessment. So again, the comment is to clarify what concentrations are used when comparing to BCGs, and if they are different than the ones used in the human health section, please explain why. (SV)
427.	Section 6.3.3.1, p. 6-21, 4th paragraph	Re: the third sentence (i.e., "Modeled effects based on analyte-specific ratios are HQs"), effects are not HQs. HQs are the ratio of exposure to effects. (DD)
428.	Section 6.3.3.2, p. 6-22, 2nd paragraph	Another limitation to tissue-based exposure estimates is the representativeness of the samples (i.e., a statistical issue). (DD)
429.	Section 6.3.3.3, p. 6-23, 1st paragraph	It is stated that, "toxicity bioassays were selected as a high weighted LOE in the risk assessment for their ability to provide site-specific information and ecologically relevant effects data." While this may be true to some extent, laboratory bioassays suffer from a lack of realism. Toxicity tests are incomplete and imperfect models (Suter, 1993). For example, a negative toxicity test cannot prove that contaminants are not responsible for observed adverse effects (e.g., decrease in prey species may exert a negative effect on target population). In addition, a toxicity test is dependent on the ecological relevance of the tested laboratory species, the representativeness of the tested abiotic sample (e.g., soil, water, sediment), and the particular exposure duration tested. Toxicity tests are best interpreted, along with multiple LOEs (e.g., Chapman and Hollert, 2006). (DD)
430.	Section 6.3.3.3, p. 6-23, 3rd paragraph	Ideally, invalidated toxicity tests should be repeated to offset data loss. (DD)
431.	Section 6.3.3.3, p. 6-23, 3rd paragraph	Phytotoxicity tests were invalid. Explain in the text how this data gap will be closed. (JV)
432.	Section 6.3.4, p. 6-23	Clam tubes were deployed at the strontium plume years earlier than the abiotic samples were collected in the strontium plume. This is inconsistent with the established approach of collecting biota and soil media samples at the same location and at the same time. Discuss in the text the uncertainty associated with this timing issue. (JV)
433.	Section 6.4, p. 6-24 – 6-50, General	Some of the subsections discuss measured tissue concentrations, while others do not. For example, there is no discussion of measured tissue concentrations for fish in section 6.4.3.4, yet in the human health section of the report, concentrations were high enough to result in high radiation doses to humans in an ingestion pathway. Further, a query for fish in the database indicates lots of results, yet there is no discussion. Clarify why some of the subsections have no discussion of tissue concentrations. Perhaps they all

Comment Number	Section, Page, Paragraph	Comment
		should include this discussion. (SV)
434.	Section 6.4, p. 6-24, 1st paragraph	Delete *explicit.* (JV)
435.	Section 6.4, p. 6-24, Bullets	Bulleted text is different than what was presented in earlier text: a. Site specific toxicity bioassays b. Comparison to lit values c. Comparison soil concentrations & benchmarks d. Field measurement Make the weighting and lines of evidence consistent throughout the text. Also, "Relevance to management goals" is not a line of evidence. Delete the bullet listing it as a line of evidence and give it no weight. (JV)
436.	Section 6.4, p. 6-24, 3rd paragraph	Limitations of the WOE approach should be acknowledged. For example, the weighting process is inherently subjective/uncertain, so that different users may reach different conclusions. (DD)
437.	Section 6.4.1.1, pg. 6-25, last sentence	Please re-write the text to: There are no statistically-significant differences between plan HIs (based on soil data) at remediated waste sites and associated reference sites. (JV)
438.	Section 6.4.1.1, Pg.6-26, 1st paragraph	Explain in the text the criteria for use of the student-t test and that for use of the Tukey-Kramer HSD, so that the reader can tell that the apparent inconsistency has a statistical basis. (JV)
439.	Section 6.4.1.1, Pg.6-26, 1st paragraph	Explain how pH & very fine sand could be considered COPCs and confounding factors. (JV)
440.	Section 6.4.1.1, p. 6-26, 1st paragraph	Re: multiple linear regression tests in Table H-7-7 (8/287 significant), was a statistical adjustment (e.g., Bonferroni) applied to control the overall Type I error rate (Stevens, 1986; Suter, 1996)? (DD)
441.	Section 6.4.1.1, p. 6-26, 3rd paragraph	The reference to Table 4-21 appears incorrect. Please check. (DD)
442.	Section 6.4.1.1, pg. 6-26, Measured tissue concentrations	Provide a more clear explanation for what was done to resolve cause of differences with correlations. (JV)
443.	Section 6.4.1.1, p. 6-26, Survival, growth from toxicity testing:	A line of evidence was lost due to the loss of terrestrial plant bioassays. Provide text explaining how this data gap will be closed. (JV)
444.	Section 6.4.1.1, p. 6-27, Upland Terrestrial Plant	The loss of the terrestrial bioassay results eliminates the ability to determine if COPCs adversely affected terrestrial plants. Plant toxicity was rated high & tests results were compromised. Rewrite text to acknowledge need for

Comment Number	Section, Page, Paragraph	Comment
	Risk Summary	further data collection & that no determinations can be made at this time. (JV)
445.	Section 6.4.1.2, p. 6-27, 1st paragraph of section	Provide a statistical basis for assuming unequal variances. (JV)
446.	Section 6.4.1.2, p. 6-27, 3rd paragraph	Hand picking terrestrial invertebrates not only "disabled field data-based estimates of relative abundance" but should also disable use of invertebrate COPC tissue concentration in exposure modeling to higher trophic levels (e.g., meadowlark, deer mouse, killdeer, grasshopper mouse), as a result of nonrandom sampling. (DD)
447.	Section 6.4.1.2, p. 6-27, 3rd paragraph	Include text acknowledging that hand-picking organisms also disabled diversity as a LOE. (JV)
448.	Section 6.4.1.2, p. 6-27, 4th paragraph	"Table 4-21" should read "Table 4-24." (DD)
449.	Section 6.4.1.2, p. 6-28, 2nd paragraph	The upland terrestrial invertebrate risk summary is problematic, due to hand picking (invalidating statistical analysis) and mixed results (i.e., Figure 6-3a vs. Figure 6-4). (DD)
450.	Section 6.4.1.3, p. 6-29, General	Noted that elevated HQs and HIs are evident, but not significantly different between remediated waste sites and reference sites. One possibility is that reference sites are also contaminated. Discuss in the text the likelihood that the reference sites are contaminated. (JV)
451.	Section 6.4.1.3, p. 6-29, 1st paragraph	Re: Figures 6-6b and 6-7a, titles are switched. Please fix. (DD)
452.	Section 6.4.1.3, p. 6-30, 2nd paragraph	"Table 4-21" should read "Table 4-24." (DD)
453.	Section 6.4.1.3, p. 6-30, Literature values for survival…	Literature values for survival, growth, or reproduction are given as a LOE with medium weight; however, this LOE is given low weight on Table 6.4. Clarify in the text. (JV)
454.	Section 6.4.1.3, p. 6-30, 3rd paragraph	Re: Figure H-6-1-2, what is the reference for the 5 mg/kg NOAEL for Pb in tissue? I could not locate this value in Table H-6. Is it specific to mammalian liver? (DD)
455.	Section 6.4.1.3, p. 6-30, Last paragraph	Does "investigation areas" refer to both operational and reference sites or just operational sites? Clarify in the text. (JV)
456.	Section 6.4.1.3, p. 6-31, 1st paragraph &	The plant community metrics supposedly didn't differ (Section 6.4.1.1, p. 6-25-6-26), so something else caused more mammals in reference site than in the operational site, could this be due to contamination? Clarify in the text.

Comment Number	Section, Page, Paragraph	Comment
	Upland Middle Trophic-Level risk Summary	(JV)
457.	Section 6.4.1.3, p. 6-31, 2nd paragraph	Provide the % of correlations of concentrations of COPC in soil vs. small mammal tissue and provide reference to data. (JV)
458.	Section 6.4.1.3, p. 6-31, 3rd and 4th paragraphs	The upland middle trophic level risk summary is difficult to interpret, due to propagation of the invertebrate bias with trophic transfer, along with mixed results (i.e., Figure 12b vs. Figure 12c). (DD)
459.	Section 6.4.1.4, p. 6-32, 3rd and 4th paragraphs	Why not specify an AUF<1 (and/or TUF<1) for upper trophic level receptors (red-tailed hawk and badger), if this can be justified? (DD)
460.	Section 6.4.1.4, p. 6-32, Upland Upper Trophic Level Risk summary and Section 6.4.2.4, p.6-39, Riparian Upper Trophic Level Risk Summary	Delete "drinking water from the river." Drinking water from the river was not used in the model. Indicate in this document that this was not done, and explain why. (JV)
461.	Section 6.4.2.1, p. 6-33, 2nd paragraph	Should "Figures 6-1c and 6-1d" read "Figures 6-15c and 6-15d?" (DD)
462.	Section 6.4.2.1, p. 6-33, 3rd paragraph	Table H-7-7 was also cited for upland plants (p. 6-26, paragraph 1). It is not clear if upland and riparian plants were evaluated collectively or separately. Please clarify. (DD)
463.	Section 6.4.2.1, p. 6-33, Diversity and abundance	Explain how pH & very fine sand could possibly be confounding factors. (JV)
464.	Section 6.4.2.1, p. 6-33-6-34, Measured tissue concentrations	What was done to resolve cause of differences with correlations? Provide better explanation in the text. (JV)
465.	Section 6.4.2.1, p. 6-33, 5th paragraph	The reference to Table 4-21 appears incorrect. Please check. (DD)
466.	Section 6.4.2.1, p. 6-34, last paragraph of	Rewrite text to acknowledge that highest weighted LOE, toxicity testing, was lost; consequently, conclusions that there is no impact on riparian plants are not supported. (JV)

Comment Number	Section, Page, Paragraph	Comment
	section	
467.	Section 6.4.2.2, p. 6-34, 4th paragraph	Similar to upland invertebrates, hand picking riparian invertebrates nullifies statistical analysis (nonrandom sampling) and compromises trophic transfer modeling. (DD)
468.	Section 6.4.2.2, p. 6-35, 3rd paragraph	The riparian invertebrate risk summary is problematic, due to hand picking (invalidating statistical analysis). (DD)
469.	Section 6.4.2.3, p. 6-37, 2nd paragraph	"Table 4-21" should read "Table 4-24." (DD)
470.	Section 6.4.2.3, p.6-37, 2nd to last paragraph of page	Rewrite last sentence of the paragraph as follows: "These confounding factors did not allow for accurate estimates of kingbird breeding success, resulting in the loss of a high-weighted line of evidence." Any efforts to replace this line of evidence should be included in the text. (JV)
471.	Section 6.4.2.3, p.6-37, last paragraph of page	Discuss in the text the possibility that contamination has altered the hormonal/genetic systems resulting in skewed gender ratios. (JV)
472.	Section 6.4.2.3, p. 6-38, 2nd paragraph	Re: Table H-7-9, the 12 COPCs (identified with slope $p<0.05$) comprised more than 5% ([12/146]*100=8.2%) of the linear regression tests. That is, more COPCs were identified than would be expected by chance alone (7 [=146*0.05] may be false positives). The alpha level should have been adjusted (e.g., Bonferroni) with multiple tests to maintain the overall alpha at 0.05 (Stevens, 1986; Suter, 1996). (DD)
473.	Section 6.4.2.3, p. 6-38, 3rd paragraph	The riparian middle trophic level risk summary is difficult to interpret, due to propagation of the invertebrate bias (nonrandom sample collection) with trophic transfer to insectivorous birds and mammals. (DD)
474.	Section 6.4.2.4, p. 6-39, 3rd and 4th paragraphs	Why not specify an AUF<1 (and/or TUF<1) for upper trophic level receptors (red-tailed hawk and badger), if this can be justified? (DD)
475.	Section 6.4.2.4, p. 6-39, 5th paragraph	Due to overlap in ecological characteristics and assessment endpoints between upland and riparian zones, not only can LOEs be summarized together (Table 6-4) but the ERA could be simplified (less redundancy) by considering only terrestrial and aquatic zones (i.e., combining upland and riparian data). Re: Table 6-4, the first column should be labeled "Receptor" or "Entity" (Not "Assessment Endpoint"), since assessment endpoint is the combination of entity plus attribute. (DD)
476.	Section 6.4.3.1, Pg. 6-40,	Provide an explanation in the text for why 'Dunnett's t-test use in lieu of a student-t. (JV)

Comment Number	Section, Page, Paragraph	Comment
	1st paragraph of section	Final decisions on this document need to include review of data from the Inter-Areas shoreline assessment.
477.	Section 6.4.3.1, p. 6-40, Aquatic Plant Risk Summary	Uncertainties about macrophytes along most of the operational areas due to river flows need further explanation and study. The validity of some phytotoxicity bioassay (with Pakchoi) was previously described as invalid and remains questionable. (JV)
478.	Section 6.4.3.2, p. 6-41, 2nd paragraph	"Tables 4-22 and 4-23" should read "Tables 4-25 and 4-26." Re: significant regressions involving iron and potassium, I thought these COPCs were excluded as essential nutrients (see p. 4-18). Please explain. (DD)
479.	Section 6.4.3.2, p. 6-42, 3rd paragraph	Re: Table 6-42, was the alpha level adjusted downward to accommodate testing the 21 histopathological dependent variables between operational and reference sites (Stevens, 1986; Suter, 1996)? (DD)
480.	Section 6.4.3.2, p. 6-43, 4th paragraph	It seems like the "Field measures of diversity and abundance" section on near shore macroinvertebrates is out of balance in terms of detail and length, relative to other LOEs. In addition, data in Tables 6-6a through 6-6c may be simplified and evaluated more efficiently with multivariate analysis (e.g., principle components), as is often done in benthic community assessment. (DD)
481.	Section 6.4.3.2, p. 6-43-44, field measures of diversity & abundance	Text is difficult to understand. Statement about stations surveyed from the chromium area indicative of higher water quality could be misleading, everything could be dead or unable to survive in these areas and this could be the reason for better water quality. You state the total number of tolerant taxa per site isn't significantly different, but the percent of such taxa is significantly lower in these plumes than other locations. Also, paragraph about richness of taxa at uranium stations is confusing. What caused the very low abundance of crustaceans and mollusks? Wouldn't this effect data on abundance & diversity as well as toxicity? Please rewrite text for clarity. (JV)
482.	Section 6.4.3.2, p. 6-44, 1st paragraph	It is stated that "stations from the chromium plume are indicative of higher water quality," although this is difficult to see in Figure 6-36. Please clarify. (DD)
483.	Section 6.4.3.2, p. 6-45, 2nd paragraph	Mayfly abundance was compared to chromium, uranium and the ref sites: Also discuss comparisons made for any other metals (e.g. Hg). (JV)
484.	Section 6.4.3.2, p. 6-45, Last paragraph	Clarify in the text whether or not the comparisons were made between the ref and operational sites only. (JV)
485.	Section 6.4.3.2, p. 6-46, 3rd paragraph	Re: the benthic macroinvertebrate risk summary, Hyallela sediment toxicity test results (Figures 6-35a and b) indicate adverse effects at chromium plume sites. (DD)

Comment Number	Section, Page, Paragraph	Comment
486.	Section 6.4.3.2, p. 6-46, Benthic Macro invertebrate risk summary	Provide in the text more explanation of confounding factors. (JV)
487.	Section 6.4.3.2, p. 6-46, 1st paragraph of section	How will the data gap for measured tissue concentrations for amphibians be resolved? Provide clarifying text. (JV)
488.	Section 6.4.3.4, p. 6-47, 1st paragraph of section	This section discusses the sum of fractions of radionuclide concentrations in abiotic media compared to BCGs for fish, birds, and mammals. Specifically, it states that the SOFs approach a value of unity associated with water. Please specify exactly what water this refers to. Is it seep water, river water, groundwater, or what? Hopefully it is not groundwater since these biota do not have access to groundwater, and hopefully it is not seep water as the likelihood of these biota encountering seep water compared to river water is extremely small. In addition, the text states the elevated SOFs are due to using detection limits for concentration values for non-detected raionuclides. This is not standard procedure for radionuclides. Standard procedure for radiochemical analysis is to report a value for the concentration, regardless of whether that value is above or below some detection limit. It appears that these samples need to be reanalyzed such that concentrations are reported. (SV)
489.	Section 6.4.3.4, p.6-48, 1st full paragraph of section	Explain in the text how crayfish, not in the diet of this bird, are an appropriate substitute in the model for macroinvertebrates that would be eaten by kingbirds. (JV)
490.	Section 6.4.3.4, p.6-48, 2nd full paragraph of section	The bufflehead is an invertivorous bird. Provide rationale in the text for choosing the bufflehead as a surrogate for herbivorous ducks. Previously, it was stated that insects don't accumulate COPCs through direct contact, but plants might. (JV)
491.	Section 6.4.3.4, p. 6-49, 1st paragraph	Re-analyze PCBs with a more acceptable (lower) detection limit. (DD)
492.	Section 6.4.3.4, p. 6-49, 3rd paragraph	Re: Figure 6-54a and 54b, these badger HI figures show HI<1, but text indicates that HI>1. Please fix. (DD)
493.	Section 6.4.3.4, p. 6-49, 6th paragraph	Re: Figure 6-55a and 6-55b, does HRM=-1.43 refer to a reference site? "Figure 6-55d" should read "Figure 6-55c." Re: Table 6-7, some type of alpha adjustment is needed for multiple comparison tests (Stevens, 1986; Suter, 1996). (DD)
494.	Section 6.4.3.4,	Discuss in the text whether or not studies were based on fish of same age.

Comment Number	Section, Page, Paragraph	Comment
	p. 6-49, Fish histopathology	What explanation can you give for earlier development near Hanford? (JV)
495.	Section 6.4.3.4, p. 6-50, 2nd paragraph	Discuss in the text the possibility that the fish histopathology may relate to COPCs in the diet or water column for the fish. (JV)
496.	Section 6.4.3.4, p. 6-50, Summary, Fish	Previous statements indicate cancers for fish organs & tissues in the operational areas (gills, liver, and kidneys). Provide justification for statement 'evidence of greater contaminant uptake in fish from operational areas was not apparent." (JV)
497.	Section 6.4.3.4, p. 6-50, Summary, Birds	Modeling is questionable because of data gaps. Clarify rational for your statement. (JV)
498.	Section 6.4.3.4, p. 6-50, Summary, Bats	Delete text 'which are not key groundwater plume contaminants.' This statement doesn't belong here. (JV)
499.	Section 6.5, p. 6-51	Explain in the text how physical habitat disruption contributed to uncertainty. (JV)
500.	Section 6.5, p. 6-51, 1st paragraph	Please note explicitly that a probabilistic risk assessment (PRA) was not performed for the ERA and that PRA can be useful in assessing uncertainty. In addition, uncertainty should be distinguished from variability. Along with Tables 6-9 and 6-10, sources of uncertainty include selection of COPCs, non-detected COPCs, statistical issues associated with small sample size and non-random (judgmental) sampling (e.g., invertebrates), combining data of variable quality, parameters and models in environmental modeling (e.g., trophic transfer factors), area/temporal use factors (AUF/TUF), bioavailability, bioassays, histopathology, surrogate receptors (e.g., sculpin), a fragmented approach to spatially assessing risk (waste site by waste site), minimal evaluation of temporal variation (primarily a cross sectional study design), problems with reference site selection (e.g., use of borrow pits), toxicity reference values (TRVs), biota concentration guides (BCGs), COPC interactions (besides additivity), weighting lines of evidence (LOEs), additivity of hazard quotients, and teasing out background contributions from Hanford site risk. (DD)
501.	Section 6.6, p. 6-51, 2nd through 4th para graphs	The "Conclusions" section appears inadequate in terms of detail. Perhaps the largest issue influencing conclusions relates to the concept and selection of reference sites. The general conclusion of no Hanford eco effect relates to the validity of waste site/reference site comparisons and associated statistics, since waste site exposures/effects for many eco receptors were characterized with HI>1 (but not significantly different than reference sites). In addition, in a tiered approach, HIs could be disaggregated into smaller HI groups, comprised of COPCs with a common mode of action. Other

Comment Number	Section, Page, Paragraph	Comment
		conclusions should specify adverse effects in Hyalella sediment toxicity tests (under "Sediments: Macroinvertebrates"), data gaps with plant bioassays and amphibian collections, and problems with hand picked invertebrate samples and propagation of this statistical bias in associated trophic modeling. (DD)
502.	Tables 6-9 and 6-10, p. 6-127 – 6-137	Assure that carnivorous mammals (i.e., badgers) are on table 6-9 or 6-10 or include them as an uncertainty. (JV)
503.	Tables 6-9 and 6-10, p. 6-127 – 6-137	Review indicates either loss of lines of evidence or compromising of them. If this happens, how can any decisions be made regarding risk level for assessment endpoints? These Assessment endpoints seem to have either lost or compromised LOEs: Clarify: (1) Terrestrial/Riparian Plants: diversity & abundance, survival/growth (toxicity testing): Also for plants: How is measured tissue concentrations not related to the assessment endpoint? Disagree with NA weight assignment (2) Soil Biota: diversity & abundance. Also, How is measured tissue concentrations not related to the assessment endpoint? Disagree with NA weight assignment (3) Middle-trophic-level species: measured tissue concentrations, balanced gender ratio, relative population, reproductive rates (4) Near-shore Aquatic Plants: survival/growth(toxicity testing (5) Benthic macro-invertebrates: diversity & abundance (basket pebble sizes? And basket loss?) (6) Clam survival in situ: Excessive mortality due to floating tubes/clam histopathology (could mortality influence these results?) Also, How is measured tissue concentrations not related to the assessment endpoint? Disagree with NA weight assignment. (7) Amphibians: measured tissue concentrations/ survival/growth(toxicity testing). (8) Fish histopathology: Were the fish analysis done on fish of the same developmental stage and same gender? If not, could this have compromised results? (9) How was uncertainties accounted for in the risk determinations? (JV)
504.	Figures 6-1 – 6-55, p. 6-55 – 6-110, Box Plot figures:	Everything is lumped together, error bars are so large that everything over laps. Provide figures of individual sites. There maybe areas which need additional cleanup, but are hidden when lumped in a group. (JV)
505.	References cited in comments	• Chapman, PM and H Hollert. Should the sediment quality triad become a tetrad, a pentad, or possibly even a hexad? J Soils Sed 6:4-8. • EPA. 1989. Risk assessment guidance for Superfund (RAGS). EPA/540/1-89/002.

Comment Number	Section, Page, Paragraph	Comment
		• EPA. 2005. Human health risk assessment protocol for hazardous waste combustion facilities. EPA 530-R-05-006. • Harris, SG and BL Harper. 2004. Exposure scenario for CTUIR traditional subsistence lifeways. CTUIR, Pendleton, OR. • Hughs, MF. 2002. Arsenic toxicity and potential mechanisms of action. Toxicol Lett 133:1-16. • Nesnow, S et al. DNA damage induced by methylated trivalent arsenicals is mediated by reactive oxygen species. Chem Res Toxicol 15:1627-1634. • Stevens, J. 1986. Applied multivariate statistics for the social sciences. Lawrence Erlbaum Assoc. Pub., Hillsdale, NJ. • Stifelman, M. 2003. Letter to the editor. Risk Anal. 23(5):859-860. • Stuart, SN et al. 2004. Status and trends of amphibian declines and extinctions worldwide. Science 306:1783-1786. • Suter, GW. 1993. Ecological risk assessment. Lewis Pub., Boca Raton, FL. • Suter, GW. 1996. Abuse of hypothesis testing statistics in ecological risk assessment. HERA 2:331-347. • WDOH. 1997. Hanford guidance for radiological cleanup. WDOH/320-015, Olympia, WA. (DD)
506.	Appendix A, General	Provide in the appendix a description of each waste site given on the maps. The reader has no way of relating observations about the sites with characteristics of the sites. (BR)
507.	Appendix C, General	Ecology provided comments on a draft of the Performance Assessment. It is not clear that the version provided with this document incorporated the changes requested by Ecology. For instance, Ecology was not satisfied with taking less than 5 multi-increment samples at the sites. Ecology had provided the following comments on the performance assessment regarding the number of samples: "Ecology considers the variability in the data to be too high to allow for less than 5 MIS results at any site. The constituents showing relatively high variability include: Total Cr, hexavalent Cr, lead, nickel, nitrate, tin, PAHs, Co-60, Ra-226, Ra-228, Th-232, U isotopes, and total U." and "This data shows that choosing 5 MIS samples always gives a lower UCL so 5 should be used all the time. The first paragraph of this report states, 'the purpose of this PA was to provide information.....on variability in contaminant concentrations.' With the expansion of the scale on the box plots, figures 6-47, variability is shown between MIS samples and between MIS sites for contaminant concentrations\activities. The data supports using 5 MIS samples. JWY" Please include a discussion in the performance assessment describing how the performance assessment has been modified as a result of review by

Comment Number	Section, Page, Paragraph	Comment
		Ecology and EPA. The text on p. 1-21, 2nd to last paragraph of section 1.5.6, could be used and expanded upon to address this. (BR)
508.	Appendix C, p. C-17, Table	The 2006 MIS sampling campaign data from all locations should be summarized the same way as the 2005 MIS performance assessment data was summarized. It is confusing for the reader to understand what the history of the MIS sampling and analysis is by reading chapters 4 thru 6. (JY)
509.	Appendix D, p. D-7, 1st paragraph	Going with the best method of two detects might not be correct if the best method had QC problems. Was this considered? (JY)
510.	Appendix D, p. D-7, 2nd paragraph	Why was a quality assurance appendix not included as requested? (JY)
511.	Appendix D, p. D-18, QA	Has the QA of the many labs used been compared for consistency? What effect does this have for the uncertainty assessment of the risk assessment? (PNNL versus Washington Closure, etc.) (JY)
512.	Appendix F, General	The classification of the following sites for the gradient analysis as low-moderate with regard to contaminant concentrations may not be appropriate: Site — Characteristic — Classification 600-171 — Wide concentration range and maximum for arsenic; high for PAHs — Low-moderate 600-208 — High barium and elevated Cr (VI); high for hexa-chlorocyclohexane-β — Low-moderate 300-49 — Highest uranium — Low-moderate Riparian 6 — High for uranium — Low-moderate Riparian 7 — High for chromium, copper — Low-moderate 600-131 — High for lead — Low-moderate Include discussion in the document about how the sites compared with what was expected prior to sampling and how the data can be used in spite of the original expectations. (BR)
513.	Figure F5.1-14, p. F5-15	Please include the bivariate plots for Cr (VI) as has been done for other contaminants. Also, riparian reference site 13 is very contaminated by Cr (VI), and unique in this regard. It is also high in cadmium, thallium (exceeding the WAC 173-340 Table 749-3 level for plant protection), and zinc (exceeding the WAC 173-340 Table 749-3 level for plant, soil biota, and wildlife protection). Discuss in the document the means by which this site became contaminated with hexavalent chromium, cadmium, thallium, and zinc, and its value as a reference site given its contamination. (BR)
514.	Figure F5.1-16a, p. F5-17	Sites 600-131 and 600-132 are located near one another and both have lead concentrations in soil approaching the WAC 173-340 Method A cleanup level of 250 mg/kg. The WAC 173-340 terrestrial ecological protection

<table>
<tr><th>Comment Number</th><th>Section, Page, Paragraph</th><th>Comment</th></tr>
<tr><td></td><td></td><td>levels of 50 mg/kg (plants) and 118 mg/kg (wildlife) are exceeded in some of the soil samples from these sites. Mouse tissue lead concentration from 600-131 was 1.2 mg/kg. This area appears to need additional cleanup for human health and ecological protection. Please discuss these sites in light of a possible need for further cleanup and compare the mouse tissue lead values with benchmarks for lead in mice. (BR)</td></tr>
<tr><td>515.</td><td>Figure F5-17, p. F5-18</td><td>The Hanford area background for many elements is relatively variable with many mean and maximum values exceeding those of the samples collected in this study. This is the case for lithium (a factor of 3 greater), magnesium, manganese, cobalt, calcium, beryllium, barium, arsenic, aluminum, iron, mercury, molybdenum, potassium, selenium, silver, sodium, and vanadium. Consequently, conclusions based on comparisons with Hanford background are questionable. This should be discussed in a chapter about background as described in a previous comment. Also, use of Hanford area background in calculations should be discontinued. (BR)</td></tr>
<tr><td>516.</td><td>Figure F-5.1-38a, p. 5-39</td><td>Upland operational site 300-49 has an exceedance of the WAC 173-340-747 level for soil for the protection of groundwater of 0.32 mg/kg. It is likely that herbicides are being over applied there. This site should be remediated or monitored regularly for herbicide over application. (BR)</td></tr>
<tr><td>517.</td><td>Figure F5.1-49b, p. F5-50 and Figure F-5.1-50a, p. F5-51</td><td>Site 600-132 has exceeded the WAC 173-340 soil concentrations for protection of human health direct contact, protection of groundwater, protection of surface water and protection of wildlife for Aroclor-1254. The site also appears to exceed soil concentrations for protection of ground water and surface water for Aroclor-1260 as well. Since this site is also high in lead and near site 600-131, which has high lead levels, consider this area for further remediation. (BR)</td></tr>
<tr><td>518.</td><td>Figures F5.1-52 – F5.1-59a, p. F5-53 – F5-60</td><td>The following sites have exceedences of WAC 173-340 concentrations for organic contaminants by the pathways of soil for the protection of groundwater and/or surface water. Exceedences indicate that the combination of toxicity and mobility result in low cleanup levels. Please discuss the exceedences in the document. Further remediation may be necessary.
<table>
<tr><th>Site</th><th>Contaminant</th><th>Pathway</th></tr>
<tr><td>1607-H2</td><td>Benzo(a)pyrene</td><td>Soil, protection of surface water</td></tr>
<tr><td>“</td><td>Benzo(a)anthracene</td><td>“</td></tr>
<tr><td>“</td><td>Benzo(a)fluoranthene</td><td>“</td></tr>
<tr><td>“</td><td>Benzo(k)fluoranthene</td><td>“</td></tr>
<tr><td>100-D-49</td><td>Benzo(a)anthracene</td><td>Soil, prot. of ground & surface water</td></tr>
<tr><td>“</td><td>Benzo(a)pyrene</td><td>“</td></tr>
<tr><td>“</td><td>Benzo(a)fluoranthene</td><td>Soil, protection of surface water</td></tr>
<tr><td>“</td><td>Benzo(k)fluoranthene</td><td>“</td></tr>
<tr><td>600-171</td><td>Benzo(a)fluoranthene</td><td>Soil, protection of surface water</td></tr>
<tr><td>“</td><td>Benzo(k)fluoranthene</td><td>“</td></tr>
</table></td></tr>
</table>

Comment Number	Section, Page, Paragraph	Comment		
		1607-D2	Benzo(a)anthracene	Soil, protection of surface water
		"	Benzo(a)fluoranthene	"
		"	Benzo(k)fluoranthene	"
		Riparian 9	Benzo(a)anthracene	Soil, prot. of ground & surface water
		"	Benzo(a)fluoranthene	Soil, protection of surface water
		"	Benzo(a)pyrene	Soil, protection of ground water
		600-139	Benzo(a)fluoranthene	Soil, protection of surface water
		"	Hexachlorocyclohexane-β	Soil, prot. of ground & surface water
		JA Jones	Benzo(a)fluoranthene	Soil, protection of surface water
			Hexachlorocyclohexane-β	Soil, prot. of ground & surface water
		1607-D2 (BR)	Hexachlorocyclohexane-β	Soil, prot. of ground & surface water